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ENVIRONMENTAL ASSESSMENT BOARD



ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARINGS

VOLUME: 12

DATE: Monday, May 13, 1991

BEFORE:

HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

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ENVIRONMENTAL ASSESSMENT BOARD
ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARING

IN THE MATTER OF the Environmental Assessment Act,
R.S.O. 1980, c. 140, as amended, and Regulations
thereunder;

AND IN THE MATTER OF an undertaking by Ontario Hydro
consisting of a program in respect of activities
associated with meeting future electricity
requirements in Ontario.

Held on the 5th Floor, 2200
Yonge Street, Toronto, Ontario,
on Monday, the 13th day of May,
1991, commencing at 10:00 a.m.


VOLUME 12

B E F O R E :

THE HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

S T A F F :

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F. MACKESY		ON HER OWN BEHALF

I N D E X o f P R O C E E D I N G S

Page No.

MITCHELL PIERSON ROTHMAN,
PAUL JONATHAN BURKE,
LILY BUJA-BIJUNAS; Resumed 2003

Cross-Examination by Mr. Shepherd (cont'd) 2003

1 ---Upon commencing at 10:03 a.m.

2 THE REGISTRAR: This hearing is again in
3 session. Please be seated.

4 THE CHAIRMAN: Mr. Shepherd.

5 MR. SHEPHERD: Good morning, Mr.
6 Chairman.

7 On the matter of timing, I do anticipate
8 being finished today, hopefully, sometime
9 mid-afternoon.

10 MITCHELL PIERSON ROTHMAN,
11 PAUL JONATHAN BURKE,
 LILY BUJA-BIJUNAS; Resumed

12 CROSS-EXAMINATION BY MR. SHEPHERD: (Cont'd)

13 Q. We spent some time on Thursday
14 afternoon being as esoteric as we could possibly be on
15 forecasting in general. I would like to deal with one
16 other area. Am I echoing a lot here or is that my
17 imagination?

18 FROM THE FLOOR: Yes.

19 ---Off the record discussion.

20 MR. SHEPHERD: Is that better?

21 FROM THE FLOOR: Yes.

22 MR. SHEPHERD: Q. I would like to turn
23 to the other area of general issues relating to
24 forecasting and talk about practical aspects affecting
25 how you forecast, that is, non-professional aspects.

1 Mr. Rothman, I wonder if you can turn to
2 exhibit -- is this 128? The excerpt from your article,
3 is that 128? And before I go into this, let me say at
4 the outset, Mr. Rothman, that there is no suggestion in
5 this series of questions that any of you would do
6 anything that is unprofessional or unethical or
7 anything like that. That is not the point of the
8 series of questions.

9 So, looking at Exhibit 128, Mr. Rothman,
10 this is, in fact, an excerpt from an article you wrote
11 about 12 years ago; is that correct?

12 MR. ROTHMAN: A. It was published as an
13 article but it was actually written as a speech as you
14 can tell from the language and informality of the
15 language.

16 Q. Yes, okay. And it is about 12 years
17 ago. This is before you were at Ontario Hydro?

18 A. I infer from evidence within the full
19 article that it was written at least in 1978. It may
20 have been published a year or so later.

21 And yes, I was with the Canadian Imperial
22 Bank of Commerce at the time.

23 Q. Now, at the top of page 362 there,
24 the only page that is in the exhibit, you say, talking
25 here about forecasting in the intermediate term, and

1 this article has nothing to do with load forecasting,
2 does it?

3 A. No, it has to do with forecasting
4 energy investment, and energy investment is a fraction
5 of GDP.

6 Q. Starting the third line down, you
7 say, "First, it is a relatively safe exercise..." -
8 there you are referring to forecasting in the
9 intermediate term - "...because no one is likely to
10 call up in 12 years to point how wrong you were." That
11 sentiment presumably is at least as true with long-term
12 forecasts.

13 A. Well, you are calling me up in 12
14 years to see how wrong I was. (Laughter)

15 Q. Not about these forecasts.

16 A. And in fact, I looked it up. We
17 weren't that wrong. So... (Laughter)

18 Yes, that was partly meant as a -- as I
19 said, it was an informal speech rather than a paper.
20 But what I really meant to say there was that with this
21 length of forecast, either in this context or in the
22 context of load forecasts, you really don't know how
23 accurate the forecast was until quite a bit after the
24 forecast was made. And that is a problem that we have
25 been dealing with really throughout much of these

1 hearings.

2 It has really been underlying a lot of
3 what the discussion has been here about uncertainty,
4 and that essentially it is a recognition that the
5 forecasts have to be uncertain and that we have to be
6 able to express that uncertainty somehow, because we
7 won't know until for many years whether the forecast
8 that we have made now is accurate.

9 It leads to a question that we have been
10 talking about, again, through much of these hearings.
11 On what kind of evidence do you change a forecast that
12 hasn't yet been proven incorrect? We change our
13 forecasts for the year 2000 to 2005 annually. How do
14 we know that the original forecasts, the forecast that
15 we are changing is worse than the new one that we are
16 making.

17 And again as we look at the record, in
18 1981 and '82, Ontario Hydro did change forecasts for
19 the year 2000 and made them worse by overreacting to
20 what was then a cyclical downturn.

21 Q. Mr. Rothman, this sort of practical
22 aspect, the fact that 25 years from now you probably
23 won't be working for Ontario Hydro - I am just
24 guessing - that doesn't mean you would necessarily take
25 some sort of devil-may-care attitude to forecasting;

1 does it?

2 A. Not at all. As I said, this was a
3 speech and intended to be relatively light-hearted way
4 of expressing what I think is a series consideration:
5 that you are making a forecast for some fairly long
6 time in the future and you won't know how accurate it
7 was until sometime later.

8 As I said, I went back and I looked at
9 this and what we were essentially trying to estimate
10 was GDP as a fraction -- sorry, energy investment as a
11 fraction of total GDP, and we were within about a
12 percent except for the '86 to '90 period --

13 Q. Mr. Rothman, I am not trying to get
14 into that. I am not questioning that your forecast
15 then was right. It might have been dead-on and I am
16 perfectly happy with that. I am just trying to get at
17 the practical factors affecting forecasting.

18 Would it be fair to say that because of
19 the nature of long-term forecasting, that you are more
20 dependent on your personal professional standards.
21 That is, the standards you put into making forecasts to
22 sort of focus and motivate the correctness of your
23 forecast because nobody is going to come back to you in
24 25 years?

25 A. I am not quite sure what you mean by

1 that question. And I am not trying to be obstructive
2 here. I am just trying to get at exactly what kind of
3 question you are asking me. If you could rephrase it.

4 Q. In many circumstances in anybody's
5 job, the control factor, if you like, the thing that
6 makes them more likely to do a good job is the fact
7 that if they do a bad job, next year they are going to
8 get whacked in compensation, in losing their job, in
9 being criticized, whatever. That's not true in
10 long-term forecasting, is it?

11 And what I am getting at, isn't the
12 result of that that you have to set personal
13 professional standards for your work because nobody
14 external is going to be able to say you were wrong?

15 A. We do several things about how we set
16 standards for the quality of the forecast and how we
17 monitor that. First of all, obviously, there is some
18 ability to monitor short-term forecast; and while we
19 don't have any guarantee that an accurate short-term
20 forecast will be accurate in the long term, again
21 referring to the history of the past decade, it does
22 give at least some comfort.

23 Secondly, we do take some care to discuss
24 these forecasts with outside experts, to discuss our
25 methodology and to discuss our results. That is an

1 important check, I think, both on the quality of what
2 we are doing and how well we are doing it.

3 And finally, I agree with you that we try
4 to maintain high professional standards. I think we do
5 maintain high professional standards within the
6 division and for our forecast. The feedback that we
7 get from the outside community tells us that they agree
8 with that statement that we do maintain high
9 professional standards. We try also to maintain
10 forecasting methodologies that are consistent with the
11 best professional, best current professional standards.

12 Q. Now that I guess brings us, your
13 reference to the outside expert, brings us to the
14 second part of that quote, where you said:

15 "Second, it tends to produce a
16 consensus because no forecaster wants to
17 appear too different from the others
18 because he or she will then have to
19 justify the difference."
20 Perhaps you can just expand on that
21 briefly.

22 A. Yes, that really was intended as more
23 humorous than serious. I could --

24 Q. Sorry, Mr. Rothman, do you agree with
25 these statements in this article that was published.

1 This was published in a book; right?

2 A. Yes.

3 Q. I don't have a copy of the speech
4 here. This was published in a book on this subject.
5 Now do you agree with the two statements that I have
6 quoted or not?

7 A. The book was a set of papers
8 delivered at a conference.

9 Q. The book wasn't a piece of humour?

10 A. No.

11 Q. Do you agree with the two statements
12 I have quoted or not?

13 A. I agree with the first statement, as
14 I said.

15 The second statement, I would put it as
16 the weight of probability; that is, I can think of
17 reasons why it would not produce a consensus and
18 reasons why it would. So, I don't hold that view
19 strongly.

20

21

22

23

24

...

25

1 [10:15 a.m.] The first, as I said, I think it is a
2 light-hearted statement of what I see as an important
3 aspect of long-term forecasting.

4 The second is a light-hearted statement
5 again of what I see as a less serious problem with
6 long-term forecasting, and that's partly because there
7 simply isn't the large community here, and we do keep
8 in touch with each other, but I don't think that we
9 deliberately try to produce consensus.

10 Q. Can you tell us what the Delphi
11 method is, can you describe it briefly?

12 A. It's an interactive process of
13 arriving at consensus among forecasters.

14 Q. How does it work?

15 A. Typically, there is a first survey
16 for some forecast variable done among a group of
17 experts or forecasters. The results of that first
18 survey are then fed back to each of the participants
19 and they are asked to produce new forecasts, bearing in
20 mind what everyone else has produced, until eventually
21 a consensus is reached and that process is repeated
22 until eventually a consensus is reached.

23 Q. You don't have to actually get to a
24 consensus to use Delphi, right? You can also use it to
25 produce a probability distribution?

1 A. Yes, you can use it to produce a
2 range, that's right. And it is, as Mr. Burke has
3 testified, used in that way by NAERC.

4 Q. When you use techniques like Delphi
5 -- and you have used those in the past, haven't you?

6 A. I haven't. We haven't within Ontario
7 Hydro.

8 Q. You haven't?

9 A. Not as far as I know.

10 Q. We will come back to that then.

11 These are just two of the practical
12 issues that affect how you work. I am trying to get a
13 sense of what sort of other practical issues,
14 non-professional issues, affect the results of your --
15 could affect the results of your forecast. Can you
16 give us some other examples of practical things that
17 would limit or direct or put pressures on your
18 forecasts?

19 A. I don't know that this issue of
20 consensus puts issues on a forecast. I think it is
21 important, this point of consensus was to say that
22 everyone is aware, there is a small community and
23 people who are in it are aware of what other people are
24 doing. I can recall, for example, a continuing set of
25 conversations I had with a person who was then in

1 charge of forecasting for the Federal Department of
2 Energy, Mines and Resources. His forecast of
3 electricity sales growth for Ontario was much higher
4 than Ontario Hydro's by about as much as 2 per cent per
5 year, to the year 2000. And we had continuing
6 discussions about why our forecasts were so different.
7 And the next year his had gone down and ours had come
8 up a little and I continued to say to him, we are going
9 to converge but you are coming down faster than we are
10 going up.

11 It's that kind of awareness of other
12 people's forecasts and of the reasons for that, that I
13 think are important within this community, and we don't
14 have to reach or look for consensus within that
15 community, but it is important that we have some
16 understanding within that community about what the
17 sources of differences are, and I think we do get that.

18 Q. Mr. Rothman, I appreciate that you
19 are saying that the consensus point is not a strong
20 factor but perhaps we could get to the question I
21 asked, which is, what other factors, what other
22 practical factors impact on your forecasts?

23 A. Well, the practical factors of
24 forecasting in general will impact on any forecast. We
25 have talked in this hearing a fair amount about data

1 problems, and you talked, I think it was you with whom
2 I was talking about assumptions and how they feed
3 through into a forecast. We said then that one of the
4 things that may constrain the variables that you can
5 choose as explanatory variables is availability of data
6 or information on them, availability of forecasts for
7 them. That's quite a practical consideration of making
8 a forecast.

9 Q. Tell us some others.

10 A. Paul, can you help me here?

11 There are methodological considerations
12 as we have talked about.

13 Q. What about things like the lack of
14 available resources, not having enough money or enough
15 people to do the job that you might otherwise like to
16 do, is that a practical limitation?

17 A. Well, it's always a practical
18 consideration. Resources are always a practical
19 constraint, and I think we have had really, in one
20 perspective, we have quite good resources. By another
21 perspective we can always -- to do the job that we
22 would like to do and we think it is important to do, we
23 could use more.

24 Q. Haven't both Dr. Buja-Bijunas and Mr.
25 Burke testified a number of times that there were

1 things that they would have liked to better that they
2 couldn't because they just didn't have the resources?

3 A. Absolutely.

4 Q. It's a common problem, right?

5 A. Absolutely. But I think that there
6 are many things that we could usefully do, that I think
7 it would be important for us to do, but that within an
8 organization like Ontario Hydro simply not -- we just
9 simply haven't had the resources to do.

10 I think that the organization has by
11 creating the economics and forecast division,
12 maintaining the resources to it that we can have in a
13 time of resource constraints throughout the
14 organization, indicated a strong commitment to
15 forecasting and to the quality -- and an understanding
16 and acceptance of the quality of what we are doing.

17 Q. But there is always something more
18 you could do no matter how good a job you are doing,
19 there is a always something more you could be doing if
20 you had the resources.

21 A. Sure. In fact, one of the problems
22 that I started out talking about, which was data
23 constraints, is not unrelated to the problem of
24 resources.

25 Q. And you, similarly, have time

1 pressures. Didn't you, Mr. Burke, testify that perhaps
2 one of the reasons why you had the problem with the
3 bandwidth that you talked about on Wednesday was the
4 fact that the 1990 load forecast was done under pretty
5 severe pressures of time and otherwise, and it's the
6 sort of mistake that anybody can make?

7 MR. BURKE: A. Well, that's correct, and
8 I think the particular added factor this year was this
9 hearing itself and the preparation for it. So, that's
10 really what I was referring to in that instance.

11 Q. It's a common problem, like in
12 anybody's job, right, like preparing cross-examination
13 for a hearing, sometimes you have time pressures and
14 you --

15 A. One has to set one's priorities and
16 do what one can do with the available resources.

17 Q. Now, Mr. Rothman you were in the
18 private sector for a while and isn't it true that in
19 some private sector firms the forecasters are subjected
20 to sort of the corporate culture pressures, if you
21 like, organizational biases, expectations of the
22 organization that forecasts will go in a certain
23 direction, whether or not they succumb to them there
24 are those pressures there, right?

25 MR. ROTHMAN: A. I wouldn't say that I

1 observed that at CIBC. I think that they were looking
2 to the forecasters for, insofar as they used the
3 forecast for internal purposes, I think they were
4 looking for the best forecasts available.

5 Q. So, have you not seen that sort of
6 affect in other organizations, where the organization
7 sort of has a way of thinking and the forecasters are
8 expected to match that way of thinking in some way?

9 A. It is observed, but from outside the
10 organization. That is people tend to say this
11 organization or that one tends to be an optimistic
12 forecast or it tends to be a pessimistic forecast or it
13 tends to forecast patterns that would be beneficial to
14 that organization. But that's really armchair
15 empiricism and unless you have been within the
16 organization you have seen to what extent the
17 forecasters are independent, it's very hard to tell.

18 Q. So outsiders will sometimes say that
19 of forecasters but in your experience it's not normally
20 true in fact; is that fair?

21 A. I don't have broad experience. I
22 talked to other forecasters in the community and I
23 haven't heard them say that they have been pressured by
24 their organizations to forecast in one direction or
25 another, and the organizations that I have been in have

1 not influenced the direction of my forecasts but I
2 can't say whether this armchair empiricism from outside
3 the organization is correct or not.

4 Q. Another area that is sometimes talked
5 about is specific demands by management or other people
6 within the organization for specific results in the
7 forecast. You have talked about them yourself, the
8 criticism you have received internally about the size
9 of your bandwidth and the pressure, if you like, to
10 narrow the bandwidth. Again, I am not suggesting you
11 did anything unprofessional, but certainly there was a
12 motivation there caused by internal pressures, wasn't
13 there?

14 A. I got a very clear message from my
15 boss at the time, Norm McConnell that he thought that
16 the bandwidth methodology needed to be revisited, and
17 since I had expressed to him concerns of my own about
18 the bandwidth methodology it was revisited.

19 I would say that it was clear that he
20 felt that the bandwidth was too wide to be as useful as
21 the planner would like it to be. But I think it was
22 also clear that if I were to revisit the methodology
23 and to tell him and the organization that in the best
24 professional opinion of myself and my staff,
25 particularly Mr. Burke, that the bandwidth was as it

should be, then it would have stayed as it was. I am firmly convinced of that.

Q. So, this is sort of another example of you having to -- and I'm not suggesting in the face of disagreement, but you have to stick to your professional integrity, if you like, and do what you believe is right, regardless of what the organization would like to have?

• • •

1 [10:25 a.m.] A. I think the organization has every
2 right to tell me what things it wants me to forecast,
3 and I think that if the organization says, as it did in
4 this case, we would like you to revisit that
5 methodology, it has every right to do that. And I
6 think we should responsive to such signals.

7 I have not felt myself to be in a
8 position where I have to defend the integrity of the
9 forecast against an organization that wants to change
10 it. I think the organization has accepted and
11 respected that the forecast and the forecasters have to
12 maintain that integrity and haven't made -- haven't put
13 pressure on to change the forecast.

14 There is an interaction between the
15 forecaster and the organization. We certainly have
16 discussions about whether we will do an update to a
17 forecast at a given time, especially in the context of
18 the Ontario Energy Board, and I think those are quite
19 legitimate. If we were to do an update now, what would
20 happen, and we've had discussions of those kinds.

21 We've had discussions with the
22 organization that we have kind of an informal agreement
23 with the organization around the Ontario Energy Board
24 that if we're going to make a forecast update, we won't
25 make a change if it's less than a 1 per cent change in

1 the load forecast generally, because making a small
2 change produces a lot of work, and we've got to go
3 through their calculations again, and it's not
4 necessarily worth it for a small change of 1 per cent.

5 We have those kinds of conversations with
6 people in the organization about what we're going to
7 do, when we're going to do it, how we're going to do
8 it, and I think those are all legitimate --

9 Q. But those aren't discussion about
10 what your results should be?

11 A. Those are not discussions about what
12 the results should be.

13 Q. Nobody ever comes to you and says, we
14 want the median load forecast to be higher or lower.
15 We don't think we like yours very much?

16 A. No.

17 MR. BURKE: A. Can I just add something
18 to what Mr. Rothman said?

19 Q. Sure.

20 A. At the time that the initiation of
21 the revisiting of the bandwidth was being discussed,
22 there was external feedback to Ontario Hydro concerning
23 the bandwidth itself. It has been examined by the
24 Select Committee on Ontario Hydro and also the
25 technical advisory panel, whose document you've

1 included in your exhibits. Both of them made the
2 judgment - I don't think either of them did analysis of
3 this question - but both of them made the judgment that
4 they considered the band to be too wide for planning
5 purposes.

6 And that was a piece of feedback that we
7 were given to consider. I think the Ministry of Energy
8 has also expressed the same view. I can't remember
9 exactly the document, but in sort of a formal way that
10 for planning purposes the old bandwidth, the pre-1988
11 bandwidth, was too wide for planning purposes.

12 Q. Well, you've anticipated me, Mr.
13 Burke. Could you turn to Exhibit 68, page 20. That's
14 the electricity planning technical advisory panel. All
15 right? And their role was to review a predecessor to
16 the plan analytically.

17 And the technical advisory panel says at
18 page 20:

19 "...in Hydro's estimates there is a 40
20 per cent probability that actual load
21 growth will fall outside (it is not known
22 how far outside) the range between high
23 and low. Moreover, the range itself is
24 very wide: The 26,000 MW difference
25 between the high and low forecasts in the

1 year 2007 is equivalent to more than 30
2 new Darlington size nuclear reactors!
3 This adds up to an extraordinary amount
4 of uncertainty confronting the
5 decision-makers."

6 That's the criticism you're talking
7 about, isn't it?

8 A. That is the extent of it, yes.

9 Q. Now, isn't it true that that was
10 one a lot of criticisms that you had on various
11 aspects, and that you've essentially changed your
12 methodology in virtually every way that they suggested
13 you should. They said, "Do more end-use forecasting."
14 You're doing it. They said, "Upgrade and improve your
15 models." And you've done it. Isn't that true that
16 you've done virtually everything they asked you to do?

17 A. Well, they aren't the only group that
18 has asked for that sort of thing. The admonishment to
19 upgrade end-use forecasting has been made since the
20 late 70's. I think the CEG put on the table a
21 compendium of recommendations over the years to do just
22 that, to improve our econometric and end-use
23 forecasting as almost the motherhood in the load
24 forecasting business.

25 So, I don't consider those comments about

1 "improve end-use, improve econometric", were
2 particularly a departure from the trend we were already
3 on.

4 The observation about the uncertainty
5 band though came at a time when we were using one
6 methodology and several other sources. I guess this
7 particular group came after the Select Committee, that
8 it also made the same comment.

9 So, it was not something where we were on
10 a path to already. It was something that required us
11 to rethink what we were doing to see whether we still
12 agreed with our methodology or not. And the
13 methodology was developed I think in the late 70's or
14 early 80's.

15 MR. ROTHMAN: A. I don't know.

16 MR. BURKE: A. And, I guess, one of the
17 things that comes with having sort of new people in the
18 division is that new ideas come forward.

19 Q. And I'm not being critical, Mr.
20 Burke. Quite the opposite. You had quite a lot of
21 criticism in the mid-80's that you responded to; isn't
22 that true?

23 A. We responded in the sense that Mr.
24 Rothman has said. We revisited the analysis to see
25 whether or not we could justify the range we had.

1 Q. But didn't --

2 MR. ROTHMAN: A. If I could just add a
3 bit about this technical advisory panel. There were a
4 few criticisms that they made which were essentially --
5 or a few recommendations that they made, which were
6 essentially statements saying we should be doing what
7 we're doing.

8 I think they may or may not have
9 understood that we were already doing it. But in some
10 cases they said to do things that we were already
11 doing. Improving end-use modelling, they certainly
12 understood was something that we were already doing.

13 I believe from informal conversations
14 that it may have been their hope that we could
15 excelerate or increase the level of effort on end-use
16 modelling, at least partly in response to their
17 recommendation.

18 Q. I just get the impression, and maybe
19 you can correct me if I'm wrong. I just get the
20 impression that to a certain extent you're damned if
21 you do and damned if you don't. In the 80's you had a
22 certain set of things that you were doing, and you were
23 changing them and improving them, partly as a result of
24 criticism. And now you've done everything everybody
25 asked you to do, and now we're all sitting here

1 criticizing the result. Is that a fair conclusion?

2 For example, you were told, "Narrow the
3 uncertainly band. This is useless for planners." So
4 you did. And now we're sitting here telling you your
5 uncertainty band is too narrow. Isn't that right?

6 A. I don't think I've heard anybody say
7 that yet.

8 Q. Oh. Okay.

9 A. And I haven't heard anybody saying
10 that they don't think we should be doing end use
11 analysis at the level that we've been doing it. We've
12 had a lot of discussions here about how we've done that
13 analysis and what its results have been, but I don't
14 think I've heard anybody at these hearings say we
15 shouldn't have been doing that end-use analysis or that
16 they don't think it's valid.

17 Well, we have, of course, had lots of
18 discussions about the end-use analysis and some
19 questions as to its date and methodology, but I don't
20 think I've heard anybody say we shouldn't have done it.

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...

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1 [10:38 a.m.] Q. The suggestion has in fact been made,
2 hasn't it, Mr. Rothman, that your uncertainty band
3 narrowing was simply the result of internal pressures,
4 not truly the result of your discovery of a new and
5 better method, hasn't it?

6 I refer you to your cross-examination by
7 the Coalition over a week ago today. Wasn't that
8 suggestion, in fact, made to you directly?

9 MR. B. CAMPBELL: Could we have a
10 transcript reference? I don't recall it being put in
11 those terms.

12 MR. SHEPHERD: Just a second. I'll see
13 if I can find it.

14 Q. You don't recall such a suggestion
15 being made to you?

16 MR. B. CAMPBELL: That there was internal
17 pressure to narrow it in the later end?

18 MR. SHEPHERD: Yes.

19 MR. B. CAMPBELL: I don't recall that.
20 That is, to have it converge is what I
21 mean by narrowing.

22 THE CHAIRMAN: There is no doubt that
23 there was some criticism about the width of the band
24 communicated--

25 MR. B. CAMPBELL: I think that has been

1 spoken to this morning.

2 THE CHAIRMAN: --and that's been spoken
3 about this morning.

4 Are you saying there is something
5 different in that --

6 MR. ROTHMAN: We made no bones, Mr.
7 Shepherd, that the external criticism and the internal
8 statements were that the bands were wider than was
9 useful to the planners for planning purposes.

10 So, if that's all you are getting at,
11 yes, we have agreed with that, and been quite clear
12 about it all along, that the message we were getting
13 from both inside and outside the organization is that
14 the bands are too wide.

15 But the instructions that I got from my
16 boss were not 'Find a methodology that will produce a
17 narrower band.' The instructions that I got were 'Use
18 your professional methodologies to revisit the
19 bandwidth methodology and decide whether you still like
20 the one that you have or whether you have something
21 else that you would prefer.' And his instructions were
22 not 'Produce a narrower bandwidth.' His instructions
23 were 'Revisit the bandwidth methodology.' And he -- if
24 you know Norm McConnell.

25 MR. SHEPHERD: Q. I do.

1 MR. ROTHMAN: A. He used the words 'This
2 is your professional judgment.'

3 Q. Maybe I am just being dense, but I
4 guess it's -- are you telling us that Mr. McConnell did
5 not come to you or anybody did not come to you and say,
6 'We have been criticised for having a bandwidth that is
7 too wide. This is a problem. Will you look at it?'

8 Did he just come to you and say, 'I don't
9 know about this methodology. Why don't you see if you
10 can find another one, wider or narrower, it doesn't
11 matter.'

12 THE CHAIRMAN: This may be too simple,
13 but surely it's implicit that an improvement in
14 methodology will narrow a bandwidth, otherwise why
15 would you improve the methodology?

16 MR. SHEPHERD: Mr. Chairman, I don't
17 think Mr. Rothman was saying that he necessarily was
18 asked to improve the methodology.

19 Q. He was asked to revisit it and if
20 necessary find another methodology; isn't that correct?
21 Which presumably would be better.

22 MR. ROTHMAN: A. First, Mr. Chairman, I
23 think I am going to disagree slightly there.

24 THE CHAIRMAN: You can disagree
25 completely as far as I am concerned. (Laughter)

1 MR. ROTHMAN: Certainly, it's possible
2 that we could have a bandwidth that was unreasonably
3 narrow, and so improving it would be widening it to a
4 more reasonable width. So improving it means that we
5 have a bandwidth that is one which we feel better
6 represents the true uncertainty. That's the first
7 criterion.

8 The second criterion, we would hope, is
9 one that is better, more useful for planning. And I
10 was told effectively, I believe I was told by my boss
11 and I think he was quite explicit, I think he said 'You
12 should revisit your bandwidth methodology and produce a
13 new one with which you are, if you can, produce a new
14 one with which you are professionally more comfortable,
15 which you think better represents the true uncertainty
16 bandwidth than does the present one.'

17 MR. SHEPHERD: Q. Mr. McConnell wasn't
18 asking you to produce a wider bandwidth, was he?

19 MR. ROTHMAN: A. When I got the
20 instructions, he didn't say anything about wider or
21 narrower. I don't want to split hairs here, Mr.
22 Shepherd, it's quite clear that that was in a context
23 where both the system planning people and Mr. McConnell
24 and the select committee and the technical advisory
25 panel and others had criticized our bandwidth for being

1 too wide. So, you know, I don't know... I think we've
2 got enough here. I think we know what the context was.

3 And as I said, I had instructions to get
4 a better bandwidth methodology. If I had come to Mr.
5 McConnell and said, 'I can't do any better than the
6 existing bandwidth methodology; that is the best
7 methodology that we can produce because we think it
8 best represents what the uncertainty band truly is,' I
9 believe that that would have been accepted. I think he
10 would have said 'That is your best professional
11 judgment?' 'Yes.' 'Then you have to go with your
12 professional judgment. You are the professional.' I
13 think he would have been disappointed, but he would
14 have accepted that. And that's where we are.

15 Q. Fair enough.

16 A. Well, let's leave it at that. I
17 think the other thing we might say, though -- I said
18 let's leave it that and I am not going to. Well...

19 MR. B. CAMPBELL: This may not be your
20 choice.

21 MR. SHEPHERD: I am having a nice rest
22 here, so you can go ahead.

23 MR. ROTHMAN: All I wanted to say was
24 that I had been uncomfortable with the uncertainty band
25 methodology for some years and had looked at it briefly

1 in 1983 when I first got responsibility for the load
2 forecast.

3 But, quite frankly, I had neither the
4 time nor as much technical expertise as Mr. Burke to
5 carry through a thorough review, so it was not a new
6 question in 1988. It was something that had really
7 kind of been on the agenda for some time.

8 And, in fact, I think that I had actually
9 said that I would do it in '87, and we finally got to
10 it in '88, so it was not a sudden thing that we
11 reviewed the bandwidth methodology.

12 MR. SHEPHERD: Q. Just before I get to
13 your economic forecast. Just one other sort of minor
14 thing really. Mr. Burke you have raised it, and Mr.
15 Rothman, you have raised it as well, in the last couple
16 of weeks, the question of scaling of charts. I just
17 want to look at it briefly for a second.

18 The graphic I am showing you, I believe,
19 is your graphic of goods production as a percentage of
20 total Ontario GDP?

21 MR. ROTHMAN: A. It certainly look like
22 it.

23 Q. This is yours; right?

24 Am I right in understanding that you are
25 projecting a continuation of the past trend away from

1 goods production but at a shallower rate than in the
2 past?

3 A. Yes.

4 Q. Is that your testimony?

5 Now you have provided us with the actual
6 numbers behind this graph; haven't you? Through your
7 counsel, did you not provide us with the numerical data
8 behind this graph?

9 A. Yes.

10 Q. Everybody nods.

11 Well, I would like to show you then a
12 second overhead which is the same data but rescaled.
13 Can you tell us what the difference between this chart
14 and the one that you just saw, is? Numbers 1 and 2?

15 A. I am not...

16 MS. PATTERSON: What was the exhibit
17 number of the original?

18 MR. SHEPHERD: The original one, I
19 believe, was Exhibit 100, overhead No. 6 -- sorry, yes,
20 it is now 126, page 1.

21 THE CHAIRMAN: But what was the original
22 one though?

23 MR. SHEPHERD: It was originally 100,
24 page 6, I believe. Or 99 page 6.

25 MR. ROTHMAN: 99.

1 MR. SHEPHERD: Was it 99, page 6? Okay.

2 THE CHAIRMAN: And yours is 126...

3 MR. SHEPHERD: 126, page 1. And the one
4 that is up now is page 2.

5 THE CHAIRMAN: Page 2.

6 MR. ROTHMAN: I am not sure what you mean
7 by the difference. One is on an expanded vertical
8 scale.

9 MR. SHEPHERD: Q. I guess I am going to
10 ask you. Why did you select the scale you did for your
11 exhibit? It looks sort of strange to me that all the
12 numbers are sorts of pushed into the centre of the
13 chart.

14 MR. ROTHMAN: A. Well, I must admit that
15 I have again violated one of my -- one of Mr.
16 McConnell's principles and did not zero-base this
17 chart. He was a real stickler for saying 'If you want
18 to know what's really happening with the data, then you
19 have to give us a chart that has zero as the basis.'
20 If I had done that it would have been even more --

21 Q. It would have been flatter; right?

22 A. But I am not sure that I chose the
23 scale for this chart. It may just have been done by
24 the person whom I asked to plot it.

25 But I thought that that scale was

1 reasonable to indicate the pattern that I wanted. And
2 when you are looking at long-term patterns like that,
3 it is preferable not to have as a blown up a scale as
4 you used for this chart in general. This makes it look
5 as if we have quite a volatile series. And, in fact,
6 if you look at the previous chart or took it in as a
7 zero-base chart, it isn't all that volatile a series.
8 What this does is emphasize the cyclical variations to
9 some extent.

10 Q. Doesn't it also tend to demonstrate
11 that in fact the trend that you are projecting is
12 virtually identical to the trend of the previous 30
13 years?

14 A. Well, it depends.

15 Q. It just looks visually to me. I
16 don't know.

17 A. It depends on how you read it. If I
18 were to take a pencil - and I don't know how this is
19 ever going to get into a transcript - but if I were to
20 take a pencil and look for a trend in this part of it,
21 you could easily have a trend like that. And the one
22 that you've got in the forecast is like that.

23 Q. And that would be from 1981 into the
24 future; wouldn't it?

25 A. I think in fact that, you know, you

1 can -- on the other hand, as you are suggesting, you
2 can take a trend that looks like that and then one that
3 looks like that and they look pretty parallel. So, it
4 is all a question of how you read it. In fact, as I
5 recall, what I looked at, I looked at it in terms of
6 kind of a per cent per year in change.

7 Q. Yes.

8 A. And as I look at it as a per cent per
9 year change, the forecast rate - I think, my numbers
10 are right off the top of my head - is something like
11 half that of the historical period.

12 Q. The rate of change is half what it
13 was in the past?

14 A. Well, yes, I mean... We can look it
15 up.

16 Q. Well, perhaps the easiest way rather
17 than --

18 A. Exhibit 15 has the data.

19 Q. Excuse me, Mr. Rothman. Perhaps the
20 easiest way to deal with this, if your counsel has no
21 objection, is I wonder if you could undertake to
22 provide us with the numerical data or a reference to it
23 so that we can look at it.

24 A. It's filed. It's Exhibit 15, the
25 tables at the back.

1 Q. Do you have the comparative rate of
2 change for the last 30 years and the next 25?

3 THE CHAIRMAN: Hold on a second. We will
4 just take one thing at a time. Let's make sure we have
5 got the right table.

6 MR. ROTHMAN: Make sure we have got the
7 right exhibit because I may be wrong. It's in Exhibit
8 15.

9 Table 1.4 of Exhibit 15. You have to do
10 some adding up here. But, if you look, for example, at
11 the primary sector, its share of GDP fell between 1970
12 and 1990 from 6.7 to 3.5 per cent. It fell roughly in
13 half. And its forecast -- so that's 20 years. Its
14 forecast to fall in the 20 succeeding years from 3.5.
15 to 2.8 per cent, a significantly slower rate of
16 decline.

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1 [10:50 a.m.] The manufacturing sector, as I suggested,
2 has been roughly stable over that period of time. Its
3 share fell from 1970 to 1990 from 26.9 to 25.5 per
4 cent, that's partly cyclical and is forecast to stay
5 roughly at that level, 25.5 to 25.9 per cent between
6 then and 2010/2015. Those are the two most important
7 parts of the goods producing sector.

8 The construction sector is roughly
9 constant through this peak, 6.7 to 6.4 per cent from
10 1970 to '90, and then a further fall from 6.4 to just
11 under 6 per cent in 2010, but that's roughly the same
12 pace. So, it is that the rate of change is about half
13 in the forecast period of what it had been in the past.

14 If you take the other side of the coin,
15 look at the services sector, it went from 50.1 to 56.5
16 between 1970 and 1990, a gain of 6 percentage points
17 over 20 years. From 1990 to 2010, the succeeding 20
18 years, it increases by 2 percentage points. So, that
19 is roughly half the rate of change.

20 MR. SHEPHERD: Q. So is it fair to
21 conclude then, Mr. Rothman, that the visual conclusion
22 that you would make from a graph like this is, in fact,
23 misleading?

24 MR. ROTHMAN: A. As I said, it depends
25 on where you put your line, your visual line, on a

1 graph like that. And that's, I think, why - if you
2 don't object to my asking Mr. Mondrow to put the
3 previous chart up--

4 Q. Okay.

5 A. --I think the previous chart with its
6 less compressed scale, is less exaggeration of this
7 cyclical variation does give you a better idea of what
8 in fact has been happening in the previous period and
9 what the forecast is for the future.

10 Q. Is this just accidental that this
11 narrowly scaled graph was chosen or did you actually
12 choose this because it is more representative of what
13 you are forecasting?

14 A. Well, as I said, I don't remember
15 whether the person who plotted this chose this scale or
16 whether I explicitly told that person what scale to
17 use, but I can be quite explicit.

18 If they had produced plot like the one
19 you did, I would have told them, give me a plot with a
20 less expanded scale because it doesn't convey as
21 clearly the visual picture that I want. This creates
22 and impression of a great deal of instability in the
23 series which I think has been much more stable, and as
24 you suggest, can be looked at as implying that the
25 forecast is only a continuation of the trend.

1 Q. It's a common problem in presentation
2 of data in graphs, isn't it, that your scaling can
3 affect the visual conclusion that you come to?

4 A. Sure. And that's why, as I said, Mr.
5 McConnell had a very strong preference for charts that
6 started at zero.

7 Q. I am not going to do both of the
8 other examples, but I do want to do the next one, page
9 3 of Exhibit 126.

10 Dr. Buja-Bijunas, this is your overheard
11 No. 33 of Exhibit 100, isn't it?

12 DR. BUJA-BIJUNAS: A. That's correct,
13 yes.

14 Q. And I am going to show you that then
15 rescaled as page 4 of Exhibit 126. Now, in your
16 testimony you described residential electricity
17 intensity as flattening out into the future. Did you
18 expect a significant change in the rate of residential
19 intensity?

20 A. First of all, I would like to
21 emphasize that I didn't go into doing this forecast
22 expecting a certain result in terms of intensity. I
23 had expectations that there would be an impact on
24 specific appliances due to standards. I had
25 expectations regarding fuel share based on historical

1 fuel share estimates. I had expectations regarding
2 particular parameters and variables that went into the
3 forecast. How that all added up in terms of
4 electricities per household I did not have specific
5 expectations because that's not how you do end-use
6 forecasting.

7 Q. When you finish an end-use forecast,
8 you do test it to see if the results make sense, don't
9 you?

10 A. When we finished, when we finally
11 came up with the residential end-use forecast, we
12 finalized it before we put together this graph. This
13 graph was put together after the fact.

14 Q. This is output from your model, not
15 input.

16 A. That's exactly right. We finalized
17 the forecast first. When we finalize it we look at
18 individual trends, individual parameters,
19 interconsistency of parameters, rather than what
20 expectations would I have regarding intensity of
21 residential sectors.

22 Q. If the output in terms of your
23 intensity numbers in your end-use number were something
24 that was totally unexpected, totally unusual, would
25 that cause you to question the models or your inputs?

1 Let's say it had intensity dropping like a stone over
2 the next 25 years.

3 A. It would cause me to look back at
4 parameters. If it was dropping like a stone, as you
5 put it, I wouldn't go back and think, how do I increase
6 it. What I would do is go back and recheck all my
7 assumptions to make sure they are interconsistent and I
8 am comfortable with them, and if, therefore, that is
9 the result based on those parameters, that is the
10 result.

11 Q. It might be evidence of a problem,
12 mightn't it? If you had an unusual output, it might be
13 evidence of a problem with the model or the inputs? I
14 am not suggesting it is in this case, I am asking as a
15 general principle.

16 A. I guess as I said in my original
17 testimony at the very beginning, that when you look at
18 the final kilowatthour per household, if it does
19 something extremely unusual, you look back historically
20 on what that ratio was as a comfort check. And so if
21 it did do something extremely unusual, versus history,
22 which I cannot explain, then I would not be
23 comfortable. And whether that was due to the model or
24 the data or whatever, I would to investigate what was
25 the underlying reason behind it.

1 Q. Doctor, can you confirm that over the
2 last 25 years on historical data, residential
3 electricity intensity increased 70 per cent and you are
4 projecting that over the next 25 years it will increase
5 10 per cent? Can you confirm that that's about right?

6 A. I would have to look at the exact
7 figures but it sound about right.

8 Q. Is it fair to say that that is a
9 fairly significant break from the past?

10 A. In terms of growth rate, yes.

11 Q. Am I right in understanding that that
12 result comes from all of the myriad of individual
13 judgments you have made in the course of doing your
14 residential end-use forecasts? You haven't sat there
15 and said, well, I think 10 per cent would be a good
16 number.

17 A. No. The break is the result of two
18 things. One is, what has gone into the future
19 forecast, the other is, what gave rise to that growth
20 historically. And a lot of that growth is due to where
21 you are coming from. What I mean by that is, to go
22 from a situation where nobody has electrical space
23 heating to say 10 per cent of the population has
24 electrical space heating, that's quite a dramatic
25 increase. More so than if you go from 30 to 40.

1 I mean, the relative, what it would look
2 like as an intensity looks as though it has more an
3 effect on intensity if you are starting at a low base.
4 And that's part of the accounting for why the
5 accounting is increasing so much historically. You are
6 starting off on a very low electrification level.

7 Q. Now, do you do any analysis to try to
8 disaggregate this sort of result, try to determine what
9 the causes are for such a significant break,
10 empirically, rather than, as opposed to, sort of
11 getting a sense? Do you actually analyze your results
12 and say the reason for this change is 50 per cent this
13 result and 20 per cent this result?

14 A. I don't have the figures with me but
15 yes, when we looked at that relative difference, part
16 of it is due to the relative difference in construction
17 rates because the marginal fuel share for new
18 construction is much higher than for the average stock,
19 so as you have different construction rates that will
20 impact your intensity.

21 Part of it is due to the building code
22 impacts, part of it is due to the appliance uptake.
23 Both in terms of efficiency level and the actual
24 penetration of appliances, which is due to differences
25 in income levels previously as opposed to into the

1 forecast.

2 Part of it is due to the difference share
3 of types of housing. You have different energy
4 requirements for single attached homes like row housing
5 or duplexes or tri-plexes as opposed to single detached
6 homes, and that relative ratio is changing. There are
7 more row houses, semis and attached type of
8 single-family dwellings forecasted in the future due to
9 demographics than historically, and that has an impact
10 on electricity use. We have looked at the various
11 things that would cause this change.

12 The other major consideration too is this
13 growth of "other" and everyone has been sort of
14 focusing on this strong growth of "other." "Other" has
15 actually been forecast to growth as a much lower rate
16 than it has historically because within this "other"
17 category they are end-uses such as TV sets, clothes
18 dryers, supplementary secondary heating, additional
19 baseboards, and lighting, and a lot of those are near
20 saturation level and therefore will not contribute to
21 the intensity as strongly as they have in the past.

22 So, all those things were considered in
23 coming up with the forecast and all those things would
24 lead to a kilowatthour per household level that would
25 be less than it was historically.

1 Q. So, you are obviously very
2 comfortable with this significant break from the past
3 trend, aren't you? You know why it's happening.

4 A. There is a consistent scenario that
5 would explain why this would happen.

6 Q. Is any of that changed, that break
7 from the past, related to -- let me rephrase this.

8 How much of that change is related to
9 expectations of tighter environmental or efficiency
10 regulation?

11 A. I will answer that in two parts, one
12 which is the appliance standards, the impact of
13 appliance standards, and we have already discussed the
14 extent to which.

15 Q. Yes.

16 A. And we have incorporated identified
17 standards, standards that were identified at the time
18 of forecast finalization, so that's going to have an
19 impact because they would lead to greater efficiency
20 improvements that would normally be the case.

21 For end-uses where there are no standards
22 identified, when it came to our efficiency assumptions,
23 we looked at historical efficiency improvement in these
24 particular end-uses and we did literature searches,
25 looked at studies done by Lawrence Berkley Lab, et

1 cetera, to see what their judgments were regarding
2 future efficiency improvements by end-use based on the
3 sort of technologies that seemed feasible, what the
4 costs would be of those technologies, what sort of
5 savings you would get from them. So, that is sort of
6 the approach that we used.

7 Q. My question was, you have historical
8 time series data which shows a 70 per cent cumulative
9 increase over 25 years and a forecast which shows a 10
10 per cent increase over the next 25 years, cumulative,
11 how much of that shift can you quantify, how much of
12 that shift relates to increased environmental
13 regulation that you have included in your forecast? Is
14 it half of the shift, a third of the shift?

15 A. I guess I would have to calculate
16 that. I would have to...

17 Q. Can you do that for us?

18 A. Yes. The only way I can think of
19 really doing that is doing that is -- you are saying,
20 what is the impact of the standards on kilowatthours
21 per household?

22 Q. Of increased environmental regulation
23 and increased control of energy efficiencies.

24 A. Yes, I can do that.

25 Q. Thank you.

1 I am going to turn now to the economic
2 forecasts, and I don't really have a lot to ask about
3 them, some specific questions.

4 First, Mr. Rothman, I only have one small
5 matter on the GDP forecast. You said quite a number of
6 times that substantial increases in environmental
7 regulation would have a long-term negative impact on
8 GDP; that is to say, resources are directed away from
9 the production of goods and services towards
10 improvement of the environment which may be laudable
11 but doesn't create domestic product. Is that a correct
12 characterization of what you said?

13 MR. ROTHMAN: A. I said it could, and I
14 said that that would be the likely direction.

15 Q. Didn't you in fact say that one of
16 the reasons you have projected a decrease in
17 productivity growth is the impact of expected increases
18 in environmental regulation? Transcript reference is
19 page 744, if you want to check.

20 A. I think I know what that context was,
21 but let me check it. 744 did you say?

22 Q. 744 page, line 9.

23 A. Yes.

24 ...

25

1 [11:05 a.m.] Q. Am I right in understanding that you
2 have said one of the reasons why your productivity
3 growth is lower than past history is increased
4 environmental regulation?

5 A. In that context it was talking about
6 the results of the Ontec model, which I think were less
7 explicit. But, yes, we have made some judgmental
8 adjustments to productivity forecasts based at least
9 partly on the expectation of the impact of
10 environmental regulations.

11 Q. Now, do you have any empirical
12 studies or other hard data to show that increased
13 environmental regulation will, in fact, reduce GDP or
14 productivity?

15 A. Could you repeat this specific
16 question, please?

17 Q. Does Ontario Hydro have any empirical
18 studies or other hard data that shows that increased
19 environmental regulation will result in decreases in
20 GDP or productivity growth?

21 A. I believe there's an interrogatory
22 response that carries some such results, and there has
23 been extensive empirical work on the reasons for
24 productivity growth slowdown in the '70s, some of which
25 referred to the impact of the environmental regulation.

1 Q. So your answer to the question is,
2 yes, you do have empirical data?

3 A. Yes.

4 Q. So this is not merely your intuition
5 or judgment; this is something that is proven by the
6 time series or the historical data?

7 A. Well, you can find frequently enough
8 in the literature, studies that might go both ways,
9 but, yes, there is empirical evidence that suggests
10 that increased environmental regulations can be
11 associated with, can cause lower rates of measured
12 output productivity.

13 Q. Mr. Rothman, isn't it, in fact true,
14 that this subject is the matter of some considerable
15 controversy among the community of economists?

16 A. As I said, you can find studies that
17 go --

18 THE CHAIRMAN: Well, no. Just a moment.
19 Is it a matter of controversy?

20 MR. ROTHMAN: Yes, I believe there is
21 discussion.

22 THE CHAIRMAN: Okay. You can go ahead
23 now and elaborate. I just wanted to set that. That
24 was the answer to Mr. Shepherd's question, whether it
25 was a matter of controversy or not.

1 MR. ROTHMAN: Which is just to say that
2 there are studies that say both -- go both ways.

3 MR. SHEPHERD Q. Isn't it, in fact, true
4 that in the area of energy efficiency, certainly the
5 most important aspect of environmental regulation from
6 your point of view, the more efficient energy
7 production and use, isn't it, in fact, true that, for
8 the most part, you would expect a productivity
9 improvement from that because you're using a resource
10 more efficiently?

11 MR. ROTHMAN: A. It depends obviously on
12 the cost of the regulation. If you produce some
13 regulation that requires a capital investment and one
14 result of the capital investment is increased energy
15 efficiency and therefore lower energy use, then there
16 is some return to the capital investment directly.

17 So, it is possible that will produce a
18 lower cost than had you not made that investment. But
19 it's a reasonable inference that if there were such
20 investments available, that businesses would be making
21 them without regulation.

22 The reason for the regulation is either
23 to accelerate or to produce such investments all
24 together. And so it's possible that you can produce --
25 that you can lower costs by making these investments,

1 but it's more likely, in general, that if the
2 constraint of the regulation is a binding constraint,
3 that is, if it produces behavior that wouldn't have
4 occurred otherwise, then that would increase costs
5 because were it likely to decrease costs, businesses
6 would have undertaken it without the regulation.

7 Q. Do I understand you to be saying that
8 in the business world businesses make decisions based
9 on what is the economically best choice - in an
10 economist's sense, the best choice?

11 A. We could have long discussions about
12 theories of the firm.

13 Q. Do you believe that --

14 A. Let me satisfy the Chairman and give
15 you a yes-or-no answer. I am saying that. I am not
16 saying that businesses do that all the time about every
17 decision, but I am saying that I believe that a
18 reasonable description of the firm would be that over
19 some period of time it makes rational decisions.

20 I have long been a believer in the
21 behavioural theory of the firm which suggests that
22 firms, like people, have limited attention spans and
23 limited ability to rationalize at any given time. But
24 I think we've seen over the last ten years that firms
25 whose attention span is so short that they don't get to

1 major decisions that are open to them, which would have
2 a significant cost reduction, those managements don't
3 stay in power.

4 Q. What that suggests, Mr. Rothman, and
5 correct me if I'm wrong, is that you probably don't
6 need much in the way of efficiency regulation because
7 if some change is truly efficient, then the business
8 community will do it anyway; you don't have to tell
9 them to.

10 A. No. I said a couple of things. I
11 said first, if the constraint is binding, it might
12 simply accelerate investments that would have been made
13 later anyway. That is, if an investment is efficient
14 and does produce a positive payback, that's what the
15 decision that the business is likely to have made
16 anyway. But it might not have made that decision until
17 the equipment broke down and a replacement was mandated
18 by the life cycle of the equipment.

19 A regulation could accelerate that
20 decision and would therefore in the long run that
21 regulation then would be neutral in effect on GDP. It
22 would -- it might or might not produce a positive
23 effect on GDP during the period in which it accelerated
24 the investment. What we don't know is what the firm
25 would otherwise have done with that capital.

1 And so I think that there is some effect
2 of regulation of that kind. It accelerates investments
3 that would otherwise have been made. Those kinds of
4 regulations we might well choose to make in order to
5 accomplish that acceleration. Other kinds of
6 regulation are binding. They produce decisions that
7 businesses or consumers would otherwise not have made.

8 An example of an efficiency regulation
9 that is binding is in the automobile industry. There
10 has been a regulation that has bound the automobile
11 manufacturers to reduce their gasoline consumption of
12 their fleet, to increase their average fleet
13 efficiency. What we have seen over the past five years
14 or so is gasoline prices have come down, is that
15 despite the fact that the cars are, in general, more
16 efficient, the average fleet efficiency of the cars
17 being purchased has gone up. That's because as prices
18 have come down, consumers have decided that they are
19 less concerned with energy efficiency and more
20 concerned with things like power or styling or size of
21 the vehicle or whatever that is.

22 That is one the kinds of thinks that I
23 meant when I said that I don't see consumers as
24 changing patterns but still responding to the standard
25 variables of price and income, the standard

1 determinants of prices and income that determine
2 consumer behavior.

3 Now, I would say, therefore, that the
4 average fleet efficiency regulations have been binding.
5 They have caused an increase in efficiency of the total
6 automobile fleet, but it's not what consumers would
7 have chosen to do.

8 Q. That's very interesting. Let me come
9 back to electricity for a second. Do you believe that
10 electric space heating is, in a commercial context, the
11 economical decision to make if you're choosing a choice
12 of one type of space heating? Isn't your testimony, in
13 fact, that the life cycle costs of electric space
14 heating are higher than natural gas?

15 A. Yes. Life cycle costs of electric
16 space heating are higher than those of natural gas.
17 Those that the decision may be made to choose electric
18 trying space heating for various reasons, including the
19 fact that the person who pays the operating costs may
20 not be the person who pays the capital costs.

21 Q. It's not an economic decision, is it?

22 THE CHAIRMAN: I'm sorry. I didn't hear
23 that.

24 MR. SHEPHERD. Q. It's not an economic
25 decision, is it? It doesn't meet this paradigm that

1 you're talking about, about people making choices based
2 on what is the most economic choice?

3 MR. ROTHMAN: A. It does indeed. The
4 decision-maker makes the choice about what is most
5 economical for them.

6 MR. BURKE: A. As we have indicated at
7 various points, there are other factors than simply the
8 operating cost or even the capital cost of the heating
9 system that come to bear on the choice of the heating
10 system, and, for instance, in the commercial sector
11 there may be some value to the controlability of
12 electric heating and its ability to be metered locally
13 rather than having to be metered for the whole
14 building, that sort of thing.

15 Q. Well, Mr. Burke, isn't that true of
16 every area in which electrical efficiency is an issue,
17 that there are other issues besides simply the
18 efficiency?

19 A. There probably are and some to a
20 greater or lesser degree. I think you are proposing
21 that there is purely economic decision?

22 Q. No. I'm disagreeing with what Mr.
23 Rothman is saying.

24 A. Well, I think that the considerations
25 in the economics can be broader simply than the capital

1 and operating costs.

2 That is my point, that there is a value
3 to consumers of some of these other aspects of fuel
4 choice that is quantitative and, therefore, figures
5 into their choice, and, therefore, the choice is more
6 than simply a capital and operating decision. But
7 there must be some value, some dollars and sense value,
8 that consumers assign to these other benefits of
9 electricity or they wouldn't be choosing it over gas.

10 Q. So, Mr. Rothman, let's get back to
11 the point then. Have I understood you correctly then
12 to say that for the most part efficiency regulation
13 will require people to either accelerate actions that
14 would otherwise be good choices economically, or if it
15 isn't just an acceleration, then it will require them
16 to do things that reduce their overall productivity, in
17 general?

18 MR. ROTHMAN: A. Yes. As I recall my
19 original testimony on this, and it wasn't in the
20 particular section you pointed to, but as I recall my
21 testimony in direct evidence, I suggested that the
22 effect of environmental regulation on economic growth
23 would not be unambiguous, that there might well be
24 regulations that would produce efficiency gains of the
25 kinds that you're talking about.

1 [11:25 am.] Q. So, you weren't including things like
2 recycling of waste products and that sort of -- that is
3 not the type of thing you were talking about?

4 A. What I was saying was that on balance
5 I would expect that increased environmental regulation
6 would have a large enough component of
7 end-of-the-tailpipe kinds of things to produce a
8 reduction in measured GDP and measured productivity
9 growth, not that that was unambiguous.

10 That there could well be parts of an
11 environmental program or an efficiency program that
12 would produce increases in GDP because they would
13 discover more efficient ways of doing things than we
14 had had in the past or would implement them faster as
15 we have been discussing or would accelerate the
16 implementation of more efficient ways of doing things.

17 So, I am not changing what I said but I
18 am not disagreeing with your point that there may well
19 be such efficiency improvements available and that
20 environmental regulations may point them out and have
21 them adopted faster.

22 Q. Am I right in understanding that
23 you're contrasting things like scrubbers which are
24 end-of-the-tailpipe sort of things and produce no net
25 economic benefit, in fact, cost economically. And more

1 structural things like recycling which will tend to
2 produce an economic benefit. Is that a fair
3 description?

4 A. They might or might not produce an
5 economic benefit in either of those directions. It is
6 possible that things like scrubbers or, in the pulp and
7 paper industry, for example, recapture of chemical,
8 could produce enough new material or reusable material
9 that it would more than pay for its own cost. So it is
10 possible that those kinds of measures too, could
11 produce gains in productivity, not losses.

12 It is possible that energy efficiency
13 improvements could have such high capital costs that
14 they don't produce enough increases in efficiency, in
15 effect, to be worth their capital cost. It's those
16 kinds of improvements that are those on which the
17 constraint binds; that is, which would not be done by
18 businesses without the impetus of regulation, and those
19 would produce productivity reductions.

20 So, it's possible on both sides. In
21 general, I would think that it is more likely to get
22 efficiency gains, productivity gains, from efficiency
23 improvements. It is more likely to get productivity
24 losses from ends-of-the-tailpipe solutions. But they
25 are not mutually exclusive and not unique in either

1 direction.

2 MR. SHEPHERD: Mr. Chairman, I want to
3 pursue this for a few minutes longer, but perhaps this
4 is a convenient time for a break.

5 THE CHAIRMAN: You say you don't want
6 to --

7 MR. SHEPHERD: I do wish to pursue this
8 for a few minutes longer, but I am going to start
9 something new within this subject and maybe it would be
10 an appropriate time for a break.

11 THE CHAIRMAN: All right. We will take a
12 break.

13 THE REGISTRAR: We will recess for 15
14 minutes.

15 ---Recess at 11:30 a.m.

16 ---On resuming at 11:46 a.m.

17 THE REGISTRAR: This hearing is again in
18 session. Please be seated.

19 THE CHAIRMAN: Mr. Shepherd.

20 MR. SHEPHERD: Thank you, Mr. Chairman.

21 Q. Mr. Rothman, I would like you to turn
22 to Exhibit 129. Exhibit 129 is an excerpt from a study
23 done by a group called DPA Group on measures to reduce
24 greenhouse gas emissions; correct? This is the last
25 four pages of conclusions. Have you had a chance to

1 look at that?

2 MR. ROTHMAN: A. Yes.

3 Q. Is it fair to say that they conclude
4 that the measures needed to achieve the environmental
5 target are also a good idea in an economic sense; that
6 is, they will produce a net economic benefit as well?

7 A. Yes. They conclude there are
8 efficiency improvements available that will increase
9 economic efficiency as well.

10 Q. That is a pretty common conclusion of
11 economists in looking at environmental regulation;
12 isn't it?

13 A. I wouldn't --

14 Q. Of various types?

15 A. No, I wouldn't say that --

16 Q. You don't think that that's common?

17 A. No.

18 Q. You spoke last week I believe - I
19 don't remember the transcript reference - about the
20 possibility of a tripartite free trade agreement
21 including Mexico. Are you familiar with some of the
22 considerations that Mexico is looking at in that
23 negotiation? Have you followed that at all?

24 A. I haven't had a lot of time to follow
25 that, no.

1 Q. You haven't looked at the impact of
2 environmental regulation in Mexico or their views of
3 that?

4 A. No.

5 Q. Before we leave this area, isn't it
6 true that there are quite a number of other benefits,
7 economic benefits, that you get from increased
8 environmental regulation, aside from the potential of
9 productivity improvement in certain areas? Isn't it
10 true, for example, that you increase the attractiveness
11 of Ontario as a destination for more highly trained
12 workers, for academics, for scientists, et cetera;
13 isn't that true?

14 A. Yes. If you reduce -- these are some
15 of the kinds of things that we had talked about earlier
16 suggesting that although the direct effects of
17 emissions reductions, for example, are not included in
18 GDP, there may be some indirect effects that might be.
19 That's possible.

20 Q. And when you have things like
21 that, like more academics and scientists highly paid
22 people or highly trained people coming to Ontario, that
23 would generally have an upward pressure on GDP; won't
24 it?

25 A. I am not sure why you focus on highly

1 trained people and scientists. We have said that
2 increased population tends to increase output.

3 Q. Didn't you also say that as training
4 improves, as skill level improves, productivity
5 improves?

6 A. Yes.

7 Q. So, if an improved quality of life
8 brings more people like that to Ontario, isn't that
9 going to increase GDP?

10 A. I don't know. I don't particularly
11 want to split hairs over this stuff. I am just
12 concerned that you seem to be saying somehow that
13 Ontario wants to attract nice middle-class
14 intellectuals only, and that is not really what we are
15 saying.

16 Q. I am not sure I exactly said that,
17 Mr. Rothman, and I guess I will repeat my question.
18 The question is a very simple one: If you bring in
19 highly trained workers as a result of whatever, but for
20 example improved quality of life, is it or is it not
21 true that as a general rule it will improve
22 productivity and therefore GDP? Yes or no?

23 A. Yes.

24 Q. And isn't it true that a jurisdiction
25 that has tighter regulation in a particular area,

1 whether it's environmental or anything else, will tend
2 to develop indigenous industries in that area that will
3 be competitive in other jurisdictions in that
4 particular area, for example, environmental efficiency?

5 A. In that area, it might drive away
6 other industries.

7 Q. That wasn't the question though.

8 A. Yes --

9 Q. The question is if we have very tight
10 regulations in area X, is it not true that as a result
11 we are likely to have more efficient and more
12 competitive industry producing the things you need for
13 area X?

14 A. Yes. And that might be a competitive
15 advantage or it might not. If other jurisdictions
16 choose to have tight regulation in area X, then that
17 could produce opportunities for further activity. Or
18 it might simply be that those industries affected by
19 tight regulation in area X leave and so you don't have
20 any expertise at all in area X anymore, nor in its
21 associated industry.

22 It depends on how much tighter your
23 regulations are relative to other jurisdictions and to
24 what extent those other jurisdictions are interested in
25 regulating in that area.

1 Q. If the practical circumstance is that
2 Ontario becomes more efficient in a given area, has
3 tighter regulation in a given area, before other
4 jurisdictions but they ultimately catch up, isn't it
5 also true that we have an edge when they catch up?

6 A. As I said, it depends on what the
7 responses are of the industries involved.

8 Q. Ontario enacts a regulation that says
9 that all new industrial motors will be variable speed
10 high efficiency motors. Ten years later, New York then
11 enacts a similar regulation. Is it true that ten years
12 later, we have an edge, a competitive edge?

13 A. That's not necessarily true, no. Are
14 you suggesting that we have a competitive edge in the
15 production of energy-efficient motors?

16 Q. Well, both. But right now I am I
17 talking about the industries that have already shifted
18 onto the new regulation have an edge when somebody else
19 is trying to shift; isn't that right?

20 A. It might or might not. Depends on
21 whether the requirement that they buy energy-efficient
22 motors has prevented them from making other capital
23 investment that would have increased their efficiency
24 even more than would have bought buying
25 energy-efficient motors.

1 Some industries may leave Ontario because
2 it's too expensive for them to buy the energy-efficient
3 motors. Some industries may comply with the regulation
4 and buy energy-efficient motors and then be more
5 efficient than their competitors elsewhere.

6 Some industries may buy energy-efficient
7 motors and stay in Ontario but become overall less
8 efficient than their competitors elsewhere because
9 their competitors elsewhere are buying other kinds of
10 efficient productive equipment that gives them an edge
11 over Ontario industries who are only re-equipping their
12 motors, and who have been forced to do so by
13 regulation.

14 In the production of motors, if Ontario
15 already has an industry producing motors, then we might
16 well have some competitive advantage in the production
17 of energy-efficient motors assuming that that industry
18 converts. But it might simply be that we buy the
19 energy-efficient motors from outside Ontario anyway,
20 and that doesn't give us any particular edge.

21 Q. I get the impression, and please
22 correct me if I am wrong, I get the impression that
23 what you are saying is we can have more tighter
24 efficiency regulation and environmental regulation and
25 it may indeed be something that we would want to have

1 because it will make Ontario a nicer place to live, but
2 we are going to have to pay for that ultimately in less
3 economic growth. You don't get anything for nothing.

4 A. I am saying that is what I believe to
5 be the most likely outcome of such regulation. I am
6 not saying that there couldn't be regulation of a kind
7 that would produce higher economic growth and increased
8 energy efficiency at the same time.

9 But it is my judgment and my expectation
10 that the kind of regulation that we will get will on
11 balance reduce total of economic growth. And we will
12 get a better environment for it, but it will reduce
13 measured economic growth in order to do that.

14 Q. And as you have said, this judgment
15 that you have is quite a controversial judgment within
16 the economic community; is it not?

17 A. I don't think it is all that
18 controversial that end-of-the-tailpipe kinds of
19 regulation reduce productivity growth. That, I think,
20 is reasonably well-accepted.

21 Q. You believe there is a consensus on
22 that?

23 A. The economic community.

24 On the question of energy efficiency
25 improvements and whether many of those available which

1 have positive paybacks in and of themselves without
2 regulation, I think there is some controversy, so many
3 of them available that we could get a significant
4 increase in efficiency and therefore output, I think
5 there is some discussion within the community, yes.

6 Q. Now you have included in your GDP
7 forecast some increased environmental regulation,
8 haven't you, as an assumption?

9 A. Judgmentally, yes.

10 Q. Can you quantify the amount that that
11 has reduced your projection over what it would have
12 been?

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1 [12:00 p.m.] A. It's hard to be precise. I believe
2 that I testified that the LISA model would have
3 produced a rate of productivity growth a little under
4 half a per cent per year higher than what is in the
5 forecast. One of the reasons for reducing that model
6 forecast, judgmentally, was the expectation of an
7 increased environmental regulation.

8 Q. That's not the whole half of one per
9 cent?

10 A. That's not the whole half of one per
11 cent.

12 Q. Is it a little bit of, a lot of it,
13 half of it? Can you give us an idea? Are we talking
14 about a significant component of your forecast?

15 A. It's hard to quantify. I would say
16 when you say a minimum of .1 per cent of the half per
17 cent and maybe...

18 THE CHAIRMAN: .1 of the half per cent?

19 MR. ROTHMAN: Yes. So maybe .1 per cent
20 per year in growth is the minimum.

21 THE CHAIRMAN: That would be .2; wouldn't
22 it.

23 MR. ROTHMAN: Pardon me?

24 THE CHAIRMAN: It's a fifth of it anyway.

25 MR. ROTHMAN: A fifth of it, yes, or a

1 quarter of it, because it's really .4, I think.

2 To what, .2 or .3, something in that range. It's hard
3 to quantify that judgment.

4 MR. SHEPHERD: Q. So, you didn't examine
5 it expressly, you had a number of factors that made you
6 think the LISA projection was high. And so you pushed
7 it down because of the balance of all of the factors?

8 MR. ROTHMAN: A. Yes.

9 Q. So, you couldn't go back then to your
10 work and give us an actual number for what the impact
11 of increased environmental regulation is on your
12 forecast, you couldn't do that?

13 A. No, but we are working on it.

14 Q. On a new model that will do that or a
15 new technique?

16 A. We were working on some modifications
17 to the LISA model that will allow us to better quantify
18 the impacts of environmental regulation on GDP growth.

19 Q. So, there is a potential here that if
20 the economists who disagree with you on this point are
21 right. There is a potential here that your GDP
22 forecast is quite a bit too low, isn't there?

23 A. What do you mean by "quite a bit"?

24 Q. Well, it seems to me that if you
25 compound .2 of 1 per cent over 25 years you get, in

1 absolute terms, a relatively big change in GDP at the
2 end of the 25-year period; isn't that right?

3 A. Well, .2 per cent comes to, what, 5
4 per cent or so. You get a noticeable difference in
5 GDP, yes. We were talking about that earlier.

6 On the other hand, there is a real
7 potential that our GDP forecast is too high, that in
8 fact, here would be significant regulation of the
9 end-of-the-tailpipe variety and other regulations
10 forcing more expensive technologies.

11 Q. Now, these things, a question like
12 this, that is captured in your uncertainty bandwidth on
13 GDP, isn't it, or on the implicit uncertainty bandwidth
14 on GDP in your model?

15 A. Yes, I think. If we had a very
16 significant break in trend, I am not sure that that's
17 captured by the uncertainty model.

18 Q. And that's a break in the trend that
19 you have assessed to be there, which is, as you said,
20 is not one that everybody necessarily agrees with?

21 A. I am not sure what you mean.

22 Q. Don't I understand correctly that the
23 trend you have projected would have environmental
24 regulation reducing GDP, not everybody agrees with
25 that, correct?

1 A. Yes.

2 Q. So, a break in that trend of your
3 judgment, that is if the other people are right, or if
4 you're right but you are projecting the amount of
5 environmental regulation wrong, either of those things
6 would take you outside of your bandwidth; wouldn't it?

7 A. It depends on the degree to which we
8 are talking. If we are talking about a .1 per cent
9 difference or .2 per cent difference, that would be
10 covered by the bandwidth. But if we are talking about
11 essentially moving, implementing regulations that wind
12 up taking us towards zero GDP growth, then that would
13 be a break in the trend, it would not be covered by the
14 existing uncertainty bandwidth.

15 Q. Now, implicit in your bandwidth
16 methodology, if I understand correctly, is the notion
17 that there is a less than 10 per cent chance that
18 either of those two those things will be true; isn't
19 it? Either the significant break that you haven't
20 projected from an assumption point of view, or that the
21 other forecasters would be right in terms of the impact
22 and you would be wrong. Combined, you are saying there
23 is a less than 10 per cent chance of that; isn't that
24 right?

25 A. A 10 per cent chance on each side.

1 Q. Except that they both move in the
2 same direction. So if you only moved in one direction,
3 there is only a 10 per cent chance on that side, isn't
4 that right?

5 A. Perhaps I wasn't hearing you quite
6 right. I thought I heard you say that people who are
7 saying that there is increased efficiency improvement
8 available, that would be on one side and those who --
9 what also went on that side?

10 Q. I'm sorry, you're right. You are
11 correct.

12 It's the one impact, whether you're right
13 or the other economists are right, would move you in the
14 direction of higher GDP; right?

15 A. Yes.

16 Q. You are saying that there is a less
17 than 10 per cent chance that that could be true?

18 A. Yes.

19 Q. And the other impact, a significant
20 break in the amount of environmental regulation would
21 on your assumptions take you to a lower GDP and you are
22 saying there is a less than 10 per cent chance of that?

23 A. Yes.

24 Q. Let me move on, then, to an area that
25 has a number of impacts and that is interest rates.

1 First, this is your area, Mr. Rothman,
2 correct?

3 A. Yes.

4 Q. Could you give us a list or just tell
5 us the various major areas in which your interest rate
6 projections affect the DSP?

7 A. As as far as I understand, the most
8 important area in which the interest rate projection
9 affects the DSP is in the calculation of the discount
10 rate that's used for calculations of present worth.

11 Q. Well, the interest rates are
12 obviously included in your economic forecasting, right,
13 your econometric models?

14 A. I would have to check the models, but
15 I believe that our LISA model is a real model. I don't
16 think it has a monetary side directly. And if it does
17 have interest rates, I think interest rates are
18 endogenous; that is, I think interest rates are
19 determined within the model rather than being fed into
20 it as an assumption.

21 Q. So, that would mean it wouldn't
22 necessarily be -- the interest rates that come out of
23 the model, if you like, that are used to drive your
24 GDP -- sorry.

25 A. Sorry.

1 Q. The interest rates that are part of
2 the calculation of your GDP results, then, are not
3 necessarily the interest rates that you have projected
4 separately and used by Ontario Hydro, is that right?

5 If they are endogenous to the model, then
6 they are not the same ones that you have projected, are
7 they?

8 A. If they are endogenous to the model
9 and they were projected, then that's what we would have
10 in our forecast.

11 Mr. Burke reminds me that there is a
12 investment function in the LISA model and it does have
13 interest rates on the right-hand side. So I am going
14 to have to back off that and say that I would have to
15 look again at that model to know what role interest
16 rates play in it.

17 MR. BURKE: A. Maybe I could just add, I
18 think that in the long run the GDP value itself is not
19 determined by interest rates; it's determined through a
20 production function-type approach to output in the
21 Ontario economy.

22 Interest rates would perhaps affect the
23 shares of output in the long run.

24 Q. Well, Mr. Rothman, haven't you
25 testified that one of the factors in GDP growth is

1 capital formation?

2 MR. ROTHMAN: A. Yes.

3 Q. And isn't that affected by interest
4 rates?

5 A. I think it is in the model, that's
6 right.

7 Q. I am just surprised that you don't
8 know whether a factor such as interest rates is even in
9 your model or not.

10 A. I don't run the model myself.

11 Q. This wasn't actually a question that
12 I was intending to make a point on, I thought it was a
13 given.

14 If it's difficult to put your finger on,
15 there is really no point to be made from it anyway,
16 maybe we could just go on.

17 A. Let me just check it. There is a
18 long-term corporate bond rate as an explanatory
19 variable in the business investment and machinery and
20 equipment equation, and that corporate bond rate,
21 according to my variables list, is a McLeod Young Weir
22 bond rate obtained from DRI.

23 Q. So, it's not tied in any way to your
24 forecast of interest rates?

25 A. The historical data used to estimate

1 it is from DRI. It's forecast to be our forecast, I
2 presume.

3 I will just check that. It is an
4 exogenous variable.

5 Q. You also use interest rates in your
6 end-use modelling?

7 DR. BUJA-BIJUNAS: A. Interest rates are
8 used in the INDEPTH model for the industrial sector.
9 Again, for the investment function, one of the things
10 that it looks at is for a given capital expenditure,
11 typically, what percentage of the monies required have
12 to be borrowed and therefore what interest rates apply?

13 But the interest rate used there is done
14 in a sort of simplistic way. You can only ascribe one
15 interest rate for the entire forecast period. The
16 input variable cannot be changed for each year of the
17 forecast, so we just sort of use an average interest
18 rate over the forecast period.

19 Q. COMMEND and REEPS don't use interest
20 rates at all?

21 A. No, they don't. It is just the
22 industrial INDEPTH model that uses an interest rate.

23 Q. So then, in all of your forecasting
24 activities, in no case do you actually use your own
25 interest rate projections, do you?

1 A. Oh, no. The interest rate is our
2 interest rate. What I am saying is that the model
3 doesn't allow you to put in every year's interest rate;
4 all I can do is put an average interest rate over the
5 entire forecast period.

6 Q. You can't put Hydro's interest rate
7 forecast into you are model, can you, because the model
8 won't take the whole forecast?

9 A. It will not have a yearly interest
10 rate; it will just an average over the forecast period.

11 Q. And, in fact, in two of your models
12 you don't use interest rates at all?

13 A. That's correcct.

14 Q. Is there an assumption there that
15 those intersection end uses are not sensitive to
16 interest rates or is it just a limitation on the model?

17 MR. BURKE: A. I just might add. It's
18 my understanding of REEPS in terms of choices, there is
19 an implicit discount rate for end uses where the
20 discount rate is relevant. In the trade-off between
21 capital and operating costs, the choice equations
22 embedded in REEPS implicitly estimate the discount
23 rates used by consumers in making their choices which
24 may not necessarily correspond to a Hydro interest rate
25 of some kind.

1 It may be appropriate, for instance, in
2 some energy market choices that people effectively look
3 for two or three year payback and that comes out
4 empirically in the coefficients that are applied to the
5 capital and operating cost terms in the choice
6 equations.

...

1 [10:14 am] So, it's not an Hydro interest rate.
2 It's an implicit discount rate in those choice
3 equations where they exist in REEPS and COMMEND.

4 Q. Now, Hydro does, in fact, use your
5 projection of discount -- or of interest rates and
6 therefore discount factors for assessing the capital
7 costs of central generation projects, doesn't it?

8 MR. ROTHMAN: A. Yes.

9 Q. And the viability of demand-side
10 management initiatives?

11 A. Yes.

12 Q. And the amount of economic
13 non-utility generation?

14 A. Yes.

15 Q. In fact, all of its avoided cost
16 calculations in its comparison of one option to another
17 all use your interest rate projection; right?

18 A. Yes.

19 Q. Your forecasts don't use your
20 projections but your planning does?

21 A. Our forecasts do use our projections.

22 Q. Well, sorry, didn't you say that your
23 your econometric model uses McLeod Young Weir's
24 forecast; not yours?

25 A. No. No. No. I said that was a

1 McLeod Young Weir series, historical series, that we
2 get from DRI's data base, and we use that for our
3 historical estimation of the structure of the model.
4 And for the forecast, we attune the DRI model to our
5 forecast and use that input.

6 Q. Sorry. I misunderstood. So you do,
7 in fact, use your own interest rate projections in
8 LISA?

9 A. Yes.

10 Q. Okay. In the end-use modelling you
11 don't, but in the the econometric modelling, you do.

12 MR. BURKE: A. I think Dr. Buja-Bijunas
13 has just said we do use the official corporate interest
14 rates that we forecast in INDEPTH, but they cannot be
15 entered on a year-by-year basis, so they are proxied by
16 the average over the period. And probably from the
17 perspective of the sorts of decisions that are being
18 made within INDEPTH, there's no great loss in accuracy
19 as a result of that.

20 Q. Now, you project real interest rates
21 and inflation rates separately, don't you?

22 MR. ROTHMAN: A. Yes.

23 Q. And then when you need nominal
24 interest rates, you multiply the two together; is that
25 correct?

1 A. Effectively, yes.

2 Q. Sometimes you add them, sometimes you
3 multiply them, but the number is roughly the same
4 anyway, isn't it?

5 A. Yes.

6 Q. So, if you project 4 per cent
7 inflation and 3 per cent real interest rates, then
8 you'll get 7-1/2 per cent nominal interest if you add
9 and 7.6 per cent in you multiply, is that fair?

10 A. Something like that.

11 Q. It's pretty close, isn't it.

12 If your nominal interest rate
13 projections, or, indeed, your real interest rate
14 projections, I guess more to the point, were to change,
15 what effect would you expect that to have on a large
16 capital-intensive central generation facility in terms
17 of the capital cost of that facility?

18 A. The higher the real interest rate,
19 the higher the lifetime cost of any capital-using
20 facility.

21 Q. Is there a rule --

22 A. The more capital-intensive it is, the
23 higher its relative cost will become. So, what happens
24 is, as real interest rates increase, the relative costs
25 of the more capital-intensive facilities increase. The

1 relative costs, that is relative to other alternatives,
2 of the less-capital intensive alternatives decrease.

3 Q. Is there a rule of thumb for relating
4 the capital cost of a project to the increase in real
5 interest rates?

6 A. I don't know of one.

7 Q. I've been told -- correct me if I'm
8 wrong -- that commonly you would say a 1 per cent
9 increase in interest rates --

10 MR. B. CAMPBELL: Hasn't he answered this
11 question? He says he doesn't know of one. I don't
12 see how it can be --

13 THE CHAIRMAN: Well, he can ask this
14 question. He's been told. And if he knows about it,
15 he can answer it.

16 You've been told what, Mr. Shepherd?

17 MR. SHEPHERD: Q. Yes. You can tell me
18 I'm wrong, and please feel free, that a 1 per cent
19 increase in interest rates would typically produce a 10
20 per cent increase in the capital cost of a -- or the
21 lifetime cost of a capital-intensive project. Is that
22 sort of a rule of thumb that you've seen in the
23 industry?

24 MR. ROTHMAN: A. I haven't seen it used.
25 It might or might not be a valid rule of thumb.

1 Q. Okay.

2 A. Remember, we're not in the business
3 of projecting capital costs.

4 Q. Okay. So, you wouldn't know what the
5 impacts are quantitatively of your interest rate
6 projections, whether they're higher or lower? You
7 wouldn't know the impacts from a capital cost point of
8 view?

9 A. No, not directly. It is a different
10 part of the organization and it -- in a sense that
11 question gets back to what we were talking about
12 earlier. They don't come to us and say, do you realize
13 that you're increasing real interest rates? Just
14 increase the cost of "Y" activity by "X" billion
15 dollars.

16 Q. Do I understand your previous
17 testimony correctly that in your view lenders got hurt
18 in the 70's because of high inflation, and as a result,
19 they required an increased real interest rate premium
20 in the 80's?

21 A. From unanticipated high inflation,
22 yes.

23 Q. And so that's the result, that they
24 asked for higher real interest rates in the 80's; is
25 that correct?

1 A. Yes, and empirical evidence
2 suggestion that falling inflation produces higher real
3 interest rates.

4 Q. And you are projecting that this is a
5 structure shift in the economy, aren't you? That is,
6 that that expectation of higher inflation will
7 continue?

8 A. No, but that the lenders continue to
9 get a premium for the possibility of higher future
10 inflation especially as inflation continues to fall,
11 and that therefore real interest rates stay high
12 relative to those...

13 Q. Mr. Rothman, I'm going to refer you
14 to page 327 of the transcripts. It's in Volume 2.
15 You've said at page -- sorry. At line 3: "Our
16 forecast is for real interest rates to stay high for
17 some time but to start to fall in the mid-1990s."

18 And later on you've said, in effect, you
19 were the first ones to forecast those high real
20 interest rates, and now everybody else is starting to
21 agree with you. Is that sort of the sense of it?

22 A. Yes. I didn't say "the first," but
23 among the first.

24 Q. Yes. Yes. Okay. Now, your interest
25 rate projection then, if I understand this analysis

1 correctly is dependent on low and stable inflation,
2 isn't it?

3 A. Lower and stable inflation, yes.
4 Well -- yes.

5 Q. If inflation is unstable, if it moves
6 around like in the 70s and 80s, then your conclusion is
7 that you'll have much higher real interest rates; isn't
8 that true?

9 A. We would get a different pattern. If
10 inflation started to move up unexpectedly, real
11 interest rates would fall initially but would then rise
12 again.

13 Q. Your overall average would be higher,
14 wouldn't it?

15 A. I would expect that it would be.

16 Q. Substantially? If you had a repeat
17 of the 70s and 80's -- let's just take the 70s and 80s
18 and we'll move them and make them 90s and the first
19 decade of the next millenium. Would it be fair to say
20 that you would anticipate higher average real interest
21 rates, substantially higher, than you have currently
22 projected?

23 A. In the first few years of that
24 scenario I would expect lower real interest rates. In
25 the first five years, I would expect you would get

1 lower real interest rates. Over the next ten years,
2 say, I would expect higher real interest rates, and
3 over the 15-year period, I would expect real interest
4 rates to be higher, GDP growth to be lower than in our
5 forecast.

6 I would find it hard, off the top of my
7 head, to put a number on that partly because of the
8 necessity to put numbers on it to have some more clear
9 idea of what was going on and to look at it more
10 carefully. But directionally I think that's where we
11 would go.

12 Q. I'm showing you page -- why don't we
13 just go to page 6 of Exhibit 126. Now, this is
14 actually page 5 -- isn't it? Maybe I'm screwed up.

15 DR. CONNELL: Page 7.

16 MR. SHEPHERD: Page 7? You're right.

17 Q. Well, this is one chart of your real
18 interest rates forecasts. Let's look at page 8 though.
19 It's probably easier to follow. I'm not trying to be
20 misleading by choosing 8 over 7, as you'll see from the
21 point.

22 Now, that spikiness that you see there in
23 interest rates in the 80s, that is a result of the
24 instability of inflation in the 70s; isn't that right?

25 MR. ROTHMAN: A. Some of the spikiness,

1 the real spike that you see there, is a spike in real
2 primes in 1990, in the late 1980s and into 1990. And
3 that real spike is a function of a very tight monetary
4 policy pursued during that period.

5 Q. It wasn't really market factors so
6 much as the government just kept the rates higher?

7 A. Yes.

8 Q. But if you look at -- the important
9 figure for Hydro is the long bonds figure, isn't it?

10 A. Yes.

11 Q. And if you look at the long bonds,
12 you have in the 80s relatively higher rates and much
13 more volatile rates. And is it true that that is
14 essentially the result of inflation volatility in the
15 70s and 80s?

16 A. Well, what you have is a cyclical
17 pattern there in in long bond rates with a peak in '81,
18 which was just before the start of a recession, or at
19 the start of a recession, not unusually, and a fall
20 during the recession, then a peak during the recovery,
21 and then a gradual decline from there -- a peak during
22 the very hottest phase of the recovery.

23 But I would agree that the height of the
24 peak and some extent of its volatility was due to the
25 volatility in the 80s, yes.

1 Q. Now --

2 A. Sorry. Of inflation in the 70s. And
3 the 80s, actually. The inflation peaked in -- I think
4 the actual peak of measured inflation was in '81 or so
5 and then --

6 Q. Why don't you turn back to number 7.
7 I don't want to perceive to be misleading you with the
8 chart. There's a trough there in the 70s, very low
9 real interest rates. Right?

10 A. Yes.

11 Q. Am I right in understanding that's
12 because investors didn't anticipate the extent of
13 inflation and so got caught unawares, as it were?
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...

1 [12:33 p.m] A. Neither its height nor its
2 persistence, that's right.

3 Q. Do I understand your testimony just a
4 minute ago to be that if you had the same sort of
5 volatility you would have the same sort of trough in
6 the '90s?

7 A. I don't think you would get as far
8 down in the '90s for things like the prime rate. But
9 yes, I think if you were to have a significant
10 acceleration of inflation in the early '90s that you
11 could get a trough of real prime and real long-term
12 interest rates again.

13 Q. You wouldn't anticipate that long
14 bonds would go as low as they would in the '70s,
15 though, would you?

16 A. I would not anticipate that.
17 ---Off the record discussion.

18 MR. ROTHMAN: No, I would not anticipate
19 that.

20 MR. SHEPHERD: Q. As I understand what
21 you are saying, the investors in a stable period of
22 inflation feel they have a pretty good grasp on what
23 future inflation will be, so they can make their real
24 interest rate margins finer, because they are
25 comfortable that they are covering inflation first;

1 right?

2 MR. ROTHMAN: A. Yes.

3 Q. But if there is volatility, then they
4 want to make sure they get the real interest rate so
5 they sort of have a higher expectation of long-term
6 inflation; is that right?

7 A. Yes.

8 Q. And that means that nominal interest
9 rates are higher? And real interest rates are higher?

10 A. Yes.

11 That's not the only factor. The
12 inflation volatility and the risk of higher inflation
13 in the future is not the only reason for our forecast
14 of relatively high real interest rates.

15 Q. I was going to come to that. You are
16 also anticipating some number of other factors that are
17 going to keep interest rates up; right?

18 A. Yes.

19 Q. Government deficits?

20 A. High levels of government debt
21 relative to GDP -- GMP.

22 Q. Just as an aside, you did these
23 forecasts before the latest provincial budget; didn't
24 you?

25 A. Yes.

1 Q. Did your forecast contemplate the
2 level of deficit that was in the current budget?

3 A. No.

4 Q. Is that a significant enough change
5 to make a difference?

6 A. We will look at it. I don't think so
7 at this point.

8 Q. Does that mean it is not significant
9 enough if it is one time or it's not significant if it
10 is a change over several years?

11 A. I think if it is one time it's
12 unlikely to be significant. If it's a change over
13 several years, we will have to look at it.

14 Q. You have no sense now as to whether
15 it is significant?

16 A. We are looking primarily at levels of
17 federal government debt to GDP; and relative to that,
18 the Ontario government deficit is not large now.

19 Q. You are not saying you don't look at
20 the Ontario Government situation, but it is not as
21 important a factor?

22 A. We haven't looked at it in the past
23 because the Ontario Government has not had significant
24 amounts of debt on the market, so we have not looked at
25 that question of whether their debt levels would affect

1 the aggregate level of debt, government debt to GDP.

2 But we will now, I think, have to look at it, yes.

3 Q. Most Ontario debt in fact is Ontario
4 Hydro as opposed to Ontario government; isn't it?

5 A. Yes.

6 Q. If we don't have the sort of
7 stability of inflation that you are anticipating in the
8 '90s and the next two decades, those other factors,
9 deficits, Kuwait, Eastern Europe, all those things you
10 talked about earlier would tend to push real interest
11 rates up; wouldn't they?

12 If you don't have the depressing factor
13 of stability of inflation, which you have said tends to
14 keep real interest rates down, then those other factors
15 will have freer rein to increase it; won't they?

16 A. Whether or not we have stable
17 inflation, those are factors tending to produce high
18 real interest rates.

19 Q. When you provide discount rates to --
20 I will leave that. I'll get to it later. Let's go to
21 natural gas prices. This shouldn't take long. It is
22 the last thing before we start on uncertainty.

23 I am showing you overhead No. 10, page 10
24 of Exhibit 126. And for the record I believe this is
25 No. 7 of Exhibit 100. This is your graph in fact;

1 isn't it?

2 A. Yes.

3 MR. B. CAMPBELL: Sorry, is this Mr.
4 Rothman's? It would be Exhibit 99, I believe, if it
5 was used by Mr. Rothman.

6 MR. SHEPHERD: My question was sort of
7 multi-directed, so...

8 THE CHAIRMAN: I think it is Exhibit 100.
9 It looks like it.

10 MR. SHEPHERD: Q. This is yours, Mr.
11 Burke?

12 MR. BURKE: A. Yes, that's correct.

13 Q. Now you testified, I think, that
14 natural gas prices have historically been about 50 to
15 70 per cent of electricity prices when you measure them
16 in terms of energy services delivered; isn't that
17 right? That sort of range?

18 A. I am not sure I put a number on the
19 record, but that sounds about right.

20 Q. Just the right range?

21 A. Yes. For the residential sector.

22 Q. Okay. Is there a difference in other
23 sectors?

24 A. Yes. Essentially in the residential
25 sector, the prices are, if anything, closer together

1 than they are in the commercial and industrial sectors.

2 Q. Now, the effect of that fact is that
3 natural gas has a price advantage, right, a very
4 substantial one?

5 A. Looking at pure fuel costs, it has a
6 price advantage, yes. These are efficiency adjusted by
7 the way.

8 Q. Yes I understand?

9 A. So that this is not straight market
10 prices we are looking at here.

11 Q. This is measured in terms of energy
12 services delivered; right?

13 A. Yes.

14 Q. That's what this is as well; isn't
15 it?

16 A. Yes.

17 Q. I am going to take you then to the
18 next overhead. This is an extrapolation from the data
19 underlying your overhead and your projections of
20 natural gas prices. And what it attempts to show, and
21 I should tell you that it says it shows the percentage
22 by which electricity price exceeds natural gas price,
23 but, in fact, if you look at the Y axis, that's a
24 propurtion simply because I haven't figured out how to
25 tell Quattro Pro how to write it in percentages yet.

1 So you can read those as percentages.

2 So this is intended to show the size of
3 the price advantage that natural gas has. Is that
4 clear and understandable?

5 A. Yes, I think so.

6 DR. CONNELL: Excuse me, it is not clear
7 to me what the Y axis is.

8 MR. SHEPHERD: The Y axis, actually you
9 should read it as percentages; that is 20 per cent, 40
10 per cent, 60 per cent, 80 per cent which is the amount
11 by which the electricity price exceeds the natural gas
12 price for the same energy services.

13 DR. CONNELL: Thank you.

14 THE CHAIRMAN: This is derived from the
15 previous graph?

16 MR. SHEPHERD: It's derived from the
17 previous graph and from Mr. Burke's testimony as to the
18 changes in prices that he is anticipating in
19 electricity and natural gas.

20 MR. BURKE: I believe it was Mr. Rothman
21 who spoke to the changes in future prices.

22 MR. SHEPHERD: I am getting totally
23 confused, but one of you...

24 MR. BURKE: I used this overhead to talk
25 about elasticities and their --

1 MR. SHEPHERD: I understand.

2 Q. So Mr. Rothman, then, is this a fair
3 representation of the changing relationship that you
4 see between electricity prices and natural gas prices;
5 that is, that over the next 25 years, the price
6 advantage of natural gas will fall quite substantially?
7 Is that fair?

8 MR. B. CAMPBELL: I'm sorry. You are
9 including the efficiency adjustment effect in that
10 question, I assume?

11 MR. SHEPHERD: Yes.

12 MR. ROTHMAN: I think that's right, yes.

13 MR. SHEPHERD: Q. So, if I understand
14 correctly - and let's just accept for now that the data
15 is correct and please feel free to come back and
16 correct it if you feel the underlying data is wrong -
17 that a current price advantage in the order of 130 per
18 cent is going to drop over the next 25 years to a price
19 advantage in the range of 45 per cent?

20 MR. ROTHMAN: A. Yes. That looks about
21 right.

22 Q. Now, Mr. Burke, let's come back to
23 elasticity for a second. You testified that you found
24 very little cross-price elasticity between natural gas
25 and electricity; right?

1 MR. BURKE: A. I said that on net I got
2 very little cross-price elasticity. There was a
3 positive effect in the residential sector and a
4 negative effect in the industrial sector, and they
5 offset each other so the total system demand was --
6 there was no cross-price effect in the long run.

7 Q. Now haven't you also testified that
8 in some areas, for example, own-price elasticity, your
9 data set doesn't allow you to be confident with the
10 elasticities beyond a certain point. That is, if the
11 change is too much, you are not confident with your
12 elasticity numbers? You have testified to that in --

13 A. Yes. And we have also testified to
14 the extent to which changes in cross-price
15 relationships, certainly ones in which the gas price
16 moved into very close relationship or started to exceed
17 electricity that that too would lie outside historical
18 experience and we would not be confident, that was
19 include in my direct evidence.

20 Q. Is this an example of that? Is this
21 getting close enough--

22 A. No.

23 Q. --that you would have doubt about
24 your elasticities?

25 A. No, because as you can see, we have

1 had, by the end of period we get back to the experience
2 of the early '80s, and we are in a situation where
3 natural gas has still got a 45 per cent, as you put it,
4 competitive advantage over electricity, and probably
5 the sorts of factors that are affecting interfuel
6 substitution between electricity and gas are, I think,
7 still within the range of historical experience then.

8 Q. So then you would say that in a
9 future that you are projecting like here, you would
10 anticipate that despite the size of the relative price
11 change that there would be basically no price-induced
12 net fuel shifting; isn't that right?

13 A. Yes.

14 Q. Can you tell us the basis on which
15 you concluded that natural gas prices and electricity
16 prices would move so close together?

17 MR. ROTHMAN: A. Well, we do forecast
18 increases in real electricity prices now, through this
19 period, but we have a forecast for a faster gas price
20 increases than electricity price increases.

21 That is on the basis of a forecast of
22 increased gas use in North America, significant
23 increases in gas use for electricity generation both in
24 the United States and in Canada, most importantly in
25 the United States, an increase in the integrated gas

1 market in North America, with new pipeline capacity
2 going from Canada to the United States so that Canadian
3 gas users have to compete with U.S. gas users for that
4 gas. The consequence of that is a depletion of the
5 existing resources and a need to turn to more expensive
6 resources to supply this growing market.

7 Q. Is this a forecast based -- it is not
8 a forecast based on extrapolation from past data; is
9 it? It is an analytical forecast?

10 A. Well, yes.

11 Q. You have, in fact, said that you
12 don't use any formal models in this; haven't you?

13 A. We use a mixture of models and
14 judgment; but we don't have a single formal model,
15 that's right.

16 Q. And you have also testified that it
17 is based largely on judgment; haven't you?

18 A. Yes. There is a large element of
19 judgment in that forecast.

20 Q. Now is this a consensus of
21 forecasters? Is that how you do it?

22 A. No. It's a forecast essentially by
23 our fossil fuel analyst.

24 Q. You have one person doing it?

25 A. One person.

1 Q. And it is that person's judgment that
2 is relevant here?

3 A. Yes.

4 Q. They are the only person making these
5 judgments.

6 A. Primarily. We are certainly in
7 contact with other forecasters and we subscribe to at
8 least two external forecast -- actually, three external
9 energy forecast services. We use those forecasts as
10 well and we discuss forecasts with other forecasters,
11 but this is essentially that analyst's judgment
12 informed by all of this information that he can get.

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1 [12:43 p.m.] Q. And this is a gas price specialist,
2 person from the gas industry?

3 A. He is responsible for the fossil fuel
4 prices, the fossil fuels.

5 Q. Is he an economist or an oil and gas
6 industry person?

7 A. An economist.

8 Q. Somebody who's worked in the oil and
9 gas industry though.

10 A. No.

11 Q. Your gas price projection is
12 essentially totally reliant on the judgments of this
13 one person, isn't it?

14 A. Yes, and reviewed by me and by the
15 section head.

16 We have, as you are probably aware, had
17 our gas price projections reviewed by specifically
18 one -- well two, by two external experts, one U.S. and
19 one Canadian, for the purposes of the thermal cost
20 review.

21 Q. But then you have changed them since
22 then; haven't you?

23 A. Not significantly.

24 Q. I seem to recall that you had a
25 number of \$6.04, or something like that that you

1 reduced to \$5.80; does that ring a bell, for the price
2 25 years from now in real dollars? I am just doing
3 this from memory, I don't have it in my notes.

4 A. That's possible. If so, your memory
5 is better than mine. But I would still say that
6 calling a difference of 20 cents in current dollar
7 price on a base like that is not a big change.

8 Q. It's not that much. It's about 10
9 per cent of today's price; isn't it?

10 A. Well, I don't know. From the numbers
11 you gave, it's 20/60ths -- or about 2/60ths, about 3
12 per cent of the price in that period.

13 Q. Do you supply your natural gas price
14 forecast to the non-utility generation division for
15 their non-utility generation plan?

16 A. Yes.

17 Q. Is it fair to say that you have over
18 forecast natural gas prices, the likely result is to
19 depress the amount of economic non-utility generation?
20 Is that something that you would expect to be the case?

21 A. If the non-utility generation is gas
22 fired, yes.

23 MR. SHEPHERD: Mr. Chairman, I am
24 planning to go into the area of uncertainty, which
25 would be the rest of my questioning, perhaps we need a

1 breather before I start.

2 THE CHAIRMAN: Would it be better to
3 start after lunch, in your view?

4 MR. SHEPHERD: I think it would be
5 better, yes.

6 THE CHAIRMAN: We will come back at 2:15.

7 THE REGISTRAR: The hearing is a
8 adjourned until 2:15.

9 ---Luncheon recess at 12:47 p.m.

10 ---On resuming at 2:15 p.m.

11 THE REGISTRAR: Please come to order.
12 This hearing is again in session.

13 MR. SHEPHERD: Should we wait for Mr.
14 Campbell?

15 THE CHAIRMAN: Does the panel feel safe
16 in going ahead without Mr. Campbell?

17 MR. ROTHMAN: We feel safe enough, but we
18 fear his wrath if we do.

19 THE CHAIRMAN: Mr. Shepherd, perhaps you
20 could give us an idea of what your time frame looks
21 like at this moment.

22 MR. SHEPHERD: Well, I do this with some
23 trepidation, but I will certainly be finished before
24 the end of the day. I will not be finished by the
25 break.

1 THE CHAIRMAN: Pardon me?

2 MR. SHEPHERD: I will not be finished by
3 the break, but I will certainly be finished by the end
4 of the day.

5 THE CHAIRMAN: Who is next on the list?
6 I have next on the list Solar Energy Society, but then
7 I guess, Mr. Thompson, you are the next after that. I
8 think the Solar Energy Society wasn't going to be here
9 today.

10 MR. THOMPSON: My understanding was that
11 there had been a switch between the Solar Energy and
12 somebody else.

13 THE CHAIRMAN: That was the NAN group,
14 yes.

15 MR. THOMPSON: If they are prepared to
16 come on, start today, I don't want to interrupt any
17 other arrangements that have been made.

18 THE CHAIRMAN: But you are prepared to go
19 today, you are ready to go?

20 MR. THOMPSON: Yes. Mine will be very
21 brief, no more than five minutes, I hope.
22 ---Off the record discussion.

23 THE CHAIRMAN: Why don't you go ahead,
24 Mr. Shepherd. I think it would be all right to go
25 ahead.

1 MR. SHEPHERD: Q. All of the rest of
2 this material is on your uncertainty methodology. I
3 guess I would like to start by confirming, Mr. Burke,
4 that the uncertainty band on the load forecast, you
5 consider is very important, don't you, it's a very
6 important component of your forecast?

7 MR. BURKE: A. That the forecast is an
8 arranged forecast is an important aspect of the plan
9 and that planners should be taking into account the
10 range of results possible for load in their planning.

11 The quantification of uncertainty in
12 terms of priorities within the load forecast department
13 hard to rank in the sense that we certainly put a lot
14 of effort into improving the median load forecast and
15 the quantification of uncertainty is important, but I
16 would have difficulty prioritizing the two.

17 Q. Mr. Rothman said at an earlier
18 point - you don't need to turn this up unless you
19 disagree with it - that the forecast is a median and a
20 range; they are not separable. That is a fair
21 assessment of the situation?

22 A. Yes, and that's why I said, that we
23 would like planners to work with the range forecast for
24 planning purposes.

25 Q. And you have in fact said in your

1 load forecast itself, the written document, the
2 probability distribution associated with the median
3 forecast is as important as its central tendency,
4 correct?

5 A. Yes.

6 Q. But as you know, you do spend a lot
7 more time working on the median than you do on the
8 bandwidth?

9 A. Yes, and I think that's appropriate.

10 Q. I am not being critical. I am
11 interested in knowing why you would feel that's
12 appropriate.

13 A. Well, I think that quantifying
14 uncertainty is a difficult task but in the end I think
15 that there are going to be no absolute answers to this
16 question.

17 I think I began one of the chapters, the
18 last section, rather, of Exhibit 10 with the phrase,
19 "There will always be uncertainty about uncertainty."
20 There is a limit to what you can do in quantifying
21 long-term uncertainty, so that I think it deserves to
22 be done as well as we can do it, but past a certain
23 point I am not sure that it is worth in an infinite
24 amount of resources. It certainly is a limited
25 exercise.

1 Q. I guess I want to explore first how
2 you actually find the function that you are using to
3 estimate bandwidth. How do you come up with that
4 formula? What is the process?

5 A. Well, I think the process is quite
6 well described in Exhibit 10, and in that, on page 3,
7 we have some objectives that we were looking for in
8 developing the methodology. One of the objectives as
9 far as the function is concerned is that because we
10 want to take advantage of the information in our
11 end-use and econometric forecasts that are used to
12 derive the median forecast, that is we think that is
13 the best median forecast we can make, we put a lot of
14 effort into doing that as well as we can.

15 So, it is important that the load
16 equation track the median forecast well. It is not
17 trying to forecast; it is simply trying to track the
18 forecast we have already made through our modelling
19 methodologies. The reason we want it to track well is
20 that if it did not track well, there would be
21 distortions associated with then adjusting the results
22 of the uncertainty bands that we developed with that
23 equation to the median which we have generated using
24 the end-use and econometric and judgment approach.

25 So, the first priority is that it track

1 the load forecast that we have made. And the second
2 stage of the approach is to look to see how we can
3 develop uncertainty bands for the explanatory
4 variables. Well, in the case that we selected in
5 Exhibit 10, there is only one variable, GDP, but there
6 are other examples of equations and approaches to
7 uncertainty given in Exhibit 10, so again, we would
8 have had to have approaches for uncertainty for those
9 other explanatory variables had we gone with an
10 approach that had more than just GDP as the explanatory
11 variable.

12 So, the load equation has to have the
13 property that it tracks well. And the basis for
14 generating GDP I have talked about at several points in
15 the hearing, we want an equation that could
16 mechanistically produce for a wide range of time
17 intervals a band that was judgmentally reasonable.

18 So, we have tried to be as simple as
19 possible in these equations because the more variables
20 you have the more complex it is. Although as Exhibit
21 10 describes, we looked at an approach which had the
22 price of electricity and the price of natural gas in an
23 equation but also fitted fairly well, not as well as
24 this particular load equation with GDP and GDP squared.
25 And, in fact, that other approach with gas prices and

1 electricity prices in the equation produced an even
2 narrower band than the one we are getting with this
3 approach, but it didn't fit well and that was one
4 reason for doing it.

5 The other reason was we thought it would,
6 in the end, be more controversial how we handled the
7 uncertainty for prices for natural gas and electricity,
8 and if we could get as good or better a tracking of our
9 median forecast without introducing those variables,
10 that, in a sense, avoided a perhaps debate over things
11 that may not be that easy to resolve. As long as the
12 equation tracks well in the period for which we have a
13 forecast, that is to 2015, there really isn't the
14 factors which cause it to have a decreasing elasticity,
15 which is a property of our median forecast, come
16 through in the determination of uncertainty, and
17 really, that's what is important.

18 Q. Mr. Burke, the process you use to get
19 this, as I understand it - correct me if I am wrong -
20 that you apply a number of mathematical techniques to
21 the historical data to get a possible functional
22 relationship, correct, and then you use trial and error
23 to get one that fits; is that fair?

24 A. As you know, we have said we don't
25 think forecasting long-term should be done with single

1 equation models for a variety of reasons. There really
2 was a fairly restricted class of models that we could
3 consider as long-term forecasting models that would
4 have a chance to track the properties of our median
5 forecast derived using a much more disaggregated
6 analysis. So, it wasn't totally trial and error; there
7 is a pretty limited set of candidates.

8 Q. Once you have an equation you think
9 looks like it might be right, you talked about fit, how
10 is it that you determine that it is, in fact, the right
11 equation?

12 A. Well, for the purposes of this
13 analysis, if you turn to page 103/104 of Exhibit 9, the
14 1990 load forecast, it gives the amount of adjustment
15 required to tune, you might say, the single equation
16 model to our median forecast, and very little
17 adjustment is required to accomplish that.

18 Exhibit 9, I believe, is the 1990 load
19 forecast.

20 Q. Page 103 you said?

21 A. 104. So this equation --

22 Q. We have this numbering problem that
23 we were talking about earlier. Is 106 in my copy?

24 A. Sorry. ...

1 [2:30 p.m.) Q. That's okay.

2 A. So, essentially, we're not looking
3 here for a forecasting equation. We're looking for an
4 equation that should have sound statistical properties,
5 reasonably sound. But I don't think that is really
6 even the major criterion.

7 The essential feature is that it tracks
8 the forecast in a fairly parsimonious way because
9 certainly you could fit an equation that ultimately,
10 perfectly replicated the forecast that in the process
11 appeared as if there was no uncertainty left at all to
12 explain. So, I think simplicity in design is
13 important. We could have added variables and variables
14 and variables and reduced the residual uncertainty to
15 the point where it was fairly small, but we didn't want
16 to do that. We wanted to track with a simple equation
17 and leave as much residual uncertainty and co-efficient
18 error as was reasonable for a long-term model.

19 Q. Now, when you get an equation like
20 this, you then test it; correct?

21 A. To see whether it tracks the
22 forecast?

23 Q. Whether it tracks the forecast and
24 whether if you used it in the past, it would have
25 produced better results than what you were using in the

1 past.

2 A. Yes, and for long-term forecasts an
3 ex post test was done in the report by Dr. Cheng
4 entitled, "Forecasting Ontario Hydro's Load Growth
5 Uncertainty," which was filed along with at least
6 Interrogatories 1.9.50 -- and I don't know whether
7 there is one of yours that has it, too.

8 Q. Yes.

9 A. In the appendix to that document, he
10 gives an ex post forecast performance result for his
11 equation I think from about '76 through to about '87.
12 And while it did not have the best fit of those
13 equations, it -- that is over history in the forecast
14 simulation, it performed better than the more dynamic
15 short-term equations that we tend to use for the
16 short-term load forecast.

17 Q. Let's go to that 1976 test. When you
18 take your new equation and you forecast it from a
19 hypothetical 1976 start - all right - you take out all
20 of the data past 1976 in terms of your calculation of
21 your co-efficients; right?

22 A. We're now talking about the just
23 testing the equation itself?

24 Q. Yes. Yes.

25 A. Yes.

1 Q. So you pretend that you only have the
2 data up to 1976?

3 A. That's correct.

4 Q. And you re-estimate your
5 co-efficients based on the data that you have--

6 A. Yes.

7 Q. --at the time. Now, in a formula
8 like this you also have exogenous variables; right?
9 It's driven by an exogenous variables?

10 A. Yes.

11 Q. When you decide what -- you have to
12 know the numbers for in this case GDP in order to
13 project load?

14 A. Yes.

15 Q. You have to have some numbers for
16 GDP. Did you use the actuals or did you use what you
17 had forecast in 1976?

18 A. To test the equation's forecasting
19 performance?

20 Q. Yes.

21 A. I'm not sure exactly, but I would
22 assume, because it is the conventional approach, that
23 if you're trying to test equations relative to each
24 other, that, in fact, you can't really do an absolute
25 pure test, but you do take the actual values for GDP

1 and other explanatory variables, and really what you're
2 testing is the model's ability not, the forecasting
3 ability of those people who were forecasting exogenous
4 variables. I also believe that we did not have, or we
5 still cannot obtain a GDP forecast from '76 to '89 that
6 was made by our division to work with.

7 Q. Now, when you look at forecasting
8 error in addition in the error in the model, you also
9 have error in the explanatory variable; right?

10 A. Yes.

11 Q. You're uncertainty is comprised of
12 both?

13 A. Yes. Well, I think we have to be
14 careful whether we're talking now about forecasting or
15 we're talking about trying to estimate uncertainty.
16 Are you switching?

17 Q. No.

18 A. No. Okay. Well, to test forecast
19 accuracy, it's very difficult to test forecast accuracy
20 on an ex post basis without making some compromise
21 about what was known and what wasn't known.

22 And, really, if you play by sort of an
23 equivalent approach; that is, if you don't give
24 different sort of exogenous variables forecasts to
25 different equations, you can really do a fair test of

1 the relative forecast performance of the equation,
2 given a particular GDP forecast. That's all that
3 really can be tested with that sort of approach.

4 Q. So, you took out the component of the
5 uncertainty that relates to the exogenous variables,
6 didn't you? That's not in your test in '76?

7 A. Well, I think, again you shouldn't
8 use the word -- the word "uncertainty" isn't
9 appropriate here. You're talking about potential
10 forecast error now. You've asked me about a
11 forecasting simulation from '76 to '88 or '89, and
12 there is another source of error in the forecast
13 associated with the error in the GDP forecast that
14 would have been made at that piont.

15 And, yes, in what was done in Dr. Cheng's
16 report, the error in GDP was not taken into account.

17 Now, we did just, just so I understand
18 we're on the same wavelength here, we did provide you
19 with information on another ex post simulation for
20 uncertainty purposes in an interrogatory response, and
21 that was done differently. There we were concerned
22 about having an understanding of GDP uncertainty in the
23 future.

24 And so we estimated what we would have
25 derived using the methodology we've got here in Exhibit

1 10 for the GDP band, had we been doing this in 1976.
2 That's a different question than the forecasting side
3 of it.

4 Q. Now, Mr. Burke, as I understand your
5 previous testimony - I'm not sure whether it was you or
6 Mr. Rothman - your 1976 test showed approximately 5 per
7 cent load growth, as opposed to the 7 per cent that you
8 had forecast at the time. Is that about right?

9 A. Well, I think we could turn up the
10 interrogatory, but there were two cases presented.
11 There was the adjusted and the unadjusted case, I think
12 it was referred to.

13 The equation produced a value for GDP and
14 hence a value for load, that is, the GDP equation, that
15 result in load growth of around 5 per cent. And the
16 load forecast of the day, was 7 per cent. And if we
17 had applied the methodology that we use now, we would
18 have adjusted --

19 First of all, our equation wouldn't have
20 tracked the forecast very well, and we might at the
21 time have decided to reject that equation because it
22 certainly didn't satisfy the test that it was producing
23 at that time a load forecast similar to the one that
24 was being made at that time.

25 However, given that, we can't change

1 everything and still call it a test. We kept with the
2 same specification for the GDP equation, load equation.

3 The difference between the 5 per cent
4 that the pure model simulation would derive and the 7
5 per cent that was the forecast of the day, made the
6 difference between whether or not the bands captured
7 the actual results between '76 and '88 or '89.

8 Q. Of course isn't it true that the
9 forecast of the day also included some error in the
10 exogenous variables because you didn't redo that
11 forecast of the day having already known what was the
12 results would be in the exogenous variables, did you?

13 A. My recollection of our discussion of
14 how forecasting was done in 1976 is that - it's on the
15 record here - we certainly did not have end use and
16 econometric models. It's not clear exactly what was
17 the basis of the forecast done in 1976 for the
18 long-term.

19 We know how the first five years was
20 done, but I don't know whether there was an equation
21 that we could have -- I don't think there is an
22 equation that we could say was the basis of the
23 forecast, the load forecast, that was made in '76.

24 Q. Isn't it true that the forecasts you
25 did in 1976 would include in it some uncertainty or

1 ultimately some error resulting from those exogenous
2 variables - whether it's population, whether it's GDP,
3 whatever?

4 A. The forecast? Yes.

5 Q. It would include that? When you
6 forecast 7 per cent, it would be wrong partly because
7 your model wasn't that good and it would be wrong
8 partly because you didn't get GDP right because you
9 didn't know what GDP was going to be?

10 A. That's possible, but it's also
11 conceivable that the long-term forecast was simply run
12 out at an average rate over historical time. I do not
13 know what was the basis of the 1976 load forecast. I
14 cannot say were there exogenous available errors and
15 so on at the time. We do not have that sort of
16 information, unfortunately.

17 Q. Isn't it fair to conclude that when
18 you're comparing the 7 per cent that you had then to
19 the 5 per cent that this model produces, you're
20 comparing apples to oranges -- there's no direct
21 comparison between the two numbers?

22 A. No, I don't think that is the case.
23 I think that it was as reasonable a test as can be made
24 and I think to reject the sort of test we did would
25 essentially suggest you cannot do ex post testing

1 meaningfully.

2 Q. Am I right in understanding that the
3 7 per cent number that was --

4 A. Actually, something is occurring to
5 me.

6 Q. Go ahead.

7 A. I think you're arguing that load
8 forecast, the 7 per cent number had some uncertainty in
9 explanatory variables in it, and I have said that for
10 the purpose of testing uncertainty, that is, whether or
11 not the 80 per cent band width produced in '76 captured
12 the actuals, that we did have uncertainty -- I just
13 want to be clear that we did look at uncertainty in GDP
14 in performing that test. It was a complete simulation
15 of the system that we have.

16 So, it's not like the simulation had no
17 GDP uncertainty and implicitly the other simulation did.
18 The difference is in the median forecast, not in the
19 treatment of uncertainty. The median forecast
20 generated by this two-equation system left to its own
21 devices using the same approach we do today was a 5 per
22 cent forecast, but the treatment of uncertainty is
23 parallel to what we do today.

24 It's important to make this distinction
25 between forecasting with an equation and looking at the

1 error in the forecast and using an equation to estimate
2 uncertainty about a forecast trend line which you
3 derived, in our case, some other way.

4 Q. Maybe this is totally simplistic, but
5 I guess I've always understood that uncertainty that
6 you forecast today becomes error in the future. They
7 are two parts of the same thing.

8 A. Once you have the actual, you can
9 calculate an error from your forecast. The simulation
10 experiment that we were talking about was one in which
11 an equation left to its own devices produced 5 per
12 cent, did not track the forecast of the day very well.

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24 ...
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1 [2:45 p.m.] When we adjusted it up to the forecast of
2 7 per cent, the band did not include the result that
3 occurred. However, the observation was made that
4 perhaps if the equation was almost providing a better
5 forecast, and one more in tune with the sort of
6 forecasts we would make with today's methodology back
7 then, it might in fact -- the equation's result may be
8 more indicative of what we would do today, given that
9 it is 12 or 15 years later and the forecasting
10 methodology has evolved and we are now looking at
11 structural shifts and all kinds of things that alter
12 the load forecast from a steady 7 per cent trend rate.

13 Q. Let me go on to I guess what may be a
14 related point.

15 In your testimony on April 25th - I won't
16 give you the transcript reference unless you ask for
17 it; I think you will remember - you were somewhat
18 surprised and dismayed at the MEA's revelation that
19 your load forecast bandwidth was narrower than your GDP
20 bandwidth. Is that now solved by the way by your
21 correction last Wednesday?

22 A. No. The relationship between the GDP
23 bandwidth and the load bandwidth, I think what I was
24 dismayed about was the premise that Mr. Mark felt he
25 had gotten me to agree to. What I had agreed to was

1 that if you simulate the load equation and you include
2 errors in the co-efficients and you include errors in
3 the residuals, you will get a wider band than if you
4 simulate that equation with GDP alone.

5 But, there was a presumption that the
6 equation translated a GDP on Mr. Mark's part, and I
7 under the pressure of cross-examination - I think
8 that's what was confusing me at the time - that that
9 GDP band translates one to one into a load band, but
10 the point of the equation is that it doesn't; that by
11 the time you get to 2010, which is the point in the
12 future that all Mr. Mark's cross-examination referred
13 to, the elasticity between GDP and load is 0.85 or so.

14 And that suggests for any given value of
15 GDP, the corresponding value for load is about 85 per
16 cent as much. It shrinks the band. It says that as
17 electricity intensity decreases, changes in GDP
18 uncertainty have less and less impact on load
19 uncertainty if you don't take into account the
20 co-efficient and residual errors.

21 Q. So, this is the correction you wanted
22 to make on April 29th? This is the addition--

23 A. Yes.

24 Q. --you wanted to make on April 29?

25 A. Yes. And I can point you to the

1 places. But I can see how the misunderstanding arose
2 and it certainly confused me at the time. I will
3 certainly admit to that.

4 But the issue is the assumption that
5 essentially these uncertainties are additive; that you
6 have got GDP uncertainty and you add co-efficient
7 uncertainty and residual uncertainty. That is not what
8 is going on here. We have an equation that transforms
9 GDP into load, and we also have to take into account
10 multiplicatively the uncertainty in the co-efficient
11 and uncertainty in GDP and additively the uncertainty
12 in the residual.

13 Q. Does that mean that it is then fair
14 to conclude that it is quite reasonable to expect the
15 load forecast bandwidth to be narrower than the GDP
16 bandwidth in percentages?

17 A. Well, it depends ultimately on the
18 relationship, what the output elasticity is in your
19 forecast in the median case, and it depends on how much
20 uncertainty, which is adding to the range generated by
21 the equation comes from the co-efficients and the
22 residual.

23 If in estimating this equation, it is
24 apparent that that trend to declining intensity is
25 known with a high degree of confidence, the uncertainty

1 in that co-efficient and in the residuals may not be
2 enough to offset the 85 per cent shrinkage by 2010 in
3 the load band.

4 But, it could have been the case that
5 historically this was a very volatile relationship and
6 we would have found ourselves in a situation where the
7 load band could have been greater than the GDP band.

8 Effectively, as I said, simulating with
9 GDP alone, you are going to get less, a narrower band
10 for load than for GDP given a forecast of declining
11 elasticity, but adding in the errors on the
12 co-efficient and the residual will widen that band.
13 Whether it widens it to the point that it's actually
14 greater than the GDP band is a matter of empirical
15 determination.

16 Q. I take it then we shouldn't take
17 anything from your surprise and dismay on the 25th;
18 that that was just --

19 A. I was confused as how I had gotten
20 into the situation where the methodology which I, in
21 reviewing the transcript, described correctly but
22 perhaps not very convincingly, because I was describing
23 it in terms of the negative co-efficient on the
24 x-squared term and how that had the effect of narrowing
25 the band. It is certainly a lot clearer if I talk in

1 terms of the overall elasticity in our median forecast
2 which is replicated by this equation.

3 Q. So, in fact, using your model then,
4 it's perfectly acceptable in the appropriate
5 circumstances to have a narrower bandwidth for load
6 than it is for GDP, right--

7 A. Yes, that's correct.

8 Q. --with this elasticity?

9 Okay. Last Monday when you were being
10 cross-examined by the Coalition, I believe, there was
11 some discussion about the standard deviation for
12 population?

13 A. Yes.

14 Q. How you would have done it.

15 And I am totally confused on that.

16 Do I understand correctly that the
17 standard deviation for population controls your
18 population uncertainty band, the uncertainty of the
19 population number?

20 A. Controls which band?

21 Q. The uncertainty band or the
22 distribution, if you like, for the population number.

23 A. Yes. The standard deviation of the
24 history of compound growth rates of a population of a
25 particular period, that is, 17 years, 25 years, that

1 standard deviation is used to generate a -- that
2 standard deviation is used to a generate a distribution
3 for population uncertainty for that number of periods
4 into the future.

5 Q. Standard deviation is in fact the
6 tool you use to create probability distribution system?

7 A. Yes, that's right. As we point out,
8 this is the one statistical assumption we make in the
9 approach we have called stochastic simulation; that is,
10 we had to assume something about that distribution and
11 we assumed it was normal.

12 For the remainder of the exercise we
13 don't impose any particular distributional assumptions
14 on the standard deviations of the explanatory
15 variables.

16 Q. Am I also right in assuming the
17 changes to the uncertainty band for a population, let's
18 say have created an 80 per cent uncertainty band for
19 population, if you change that, that will have a direct
20 and concomitant impact on your uncertainty band for
21 load; correct?

22 A. It does only if you don't do what we
23 do which is to judgmentally assess whether the GDP band
24 that you derive makes sense; that is, we do a sanity
25 check on the GDP band and really it's very important to

1 us that we are in the right ballpark for GDP. Afterall
2 we are not doing this as a once-through operation; we
3 are doing this as a search for a GDP band to put into
4 our load equation.

5 And effectively if we were to come up
6 with a GDP band that didn't make sense, we would scale
7 by some other factor. Clearly we have scaled already
8 to derive the GDP band we have. That reflects a
9 judgment that without scaling we would get a
10 nonsensical GDP band and judgment in the eyes of the
11 people who produce our GDP forecast and I guess
12 relative to this survey.

13 So that, while it is mathematically
14 correct that if you string them together, don't touch
15 anything, you would get a fairly direct relationship
16 between the population standard error and the load
17 standard error. That is not the process we follow.
18 The process is laid out quite clearly. We generate a
19 population band to get a GDP band. It is the way we
20 get our GDP band. The GDP band has to be reasonable.

21 And I think I have testified to that at
22 several points in this hearing so far that the survey
23 that we have done - and right in my direct evidence -
24 the survey we do as a reasonableness check is quite
25 important.

1 We also have other benchmarks. We look
2 at the history of GDP and its growth rates without
3 doing an equation at all. As you pointed out, Mr.
4 Shepherd, on Thursday, the search for how you treat
5 that one driving variable, that last one that drives
6 everything has to be done carefully and there are
7 judgments entailed, and so we have done it carefully.

8 And it's not mechanistic, we take
9 something to population and run it right through. Or
10 else we wouldn't have scaled in the first place and we
11 would have ended up with a GDP band that no one
12 believes represents an 80 per cent confidence interval
13 for GDP.

14 Q. So, the sole way you test it then is
15 to see whether you like the answer? I am not being
16 facetious. In essence?

17 A. As I have said, there is certainly a
18 heavy judgmental element to the GDP band itself. And
19 the benchmarks we had and are described in section 5 of
20 Exhibit 10 -- well the benchmark that is described in
21 section 5 of Exhibit 10 is the survey of the external
22 economic forecast advisory committee.

23 And as it turns out, our GDP band
24 generated by the model is wider than that survey. I
25 think we accepted the extent to which it is wider than

1 the survey as something prudent, but we don't want to
2 pick the narrowest numbers around. But effectively we
3 didn't want it to be much wider than it is because, in
4 fact, we are starting to depart significantly from the
5 public, the opinion of experts in forecasting GDP.

6 Q. Let me come back to that in a second.

7 Let me just nail down this one point. If
8 you double the standard error for population, you
9 double the bandwidth for load; don't you?

10 A. I think I have been quite clear that
11 if you do it mechanistically; that is, if you run the
12 two equations together and you don't do anything to
13 assess the GDP band on the way, that is what the
14 mathematics tells you. But that is not what we do.

15 I think in an interrogatory response on
16 that question -- I don't know whether I put enough
17 caveats into the response but certainly what I was
18 giving you there was the result of mechanistically
19 doubling the standard error. Not would we, in fact, do
20 that?

21 Q. I guess I'm having a little trouble
22 understanding that. I would like you to look at page
23 103 of Exhibit 9, your page 103. This is actually out
24 of the OEB materials, so the numbering is correct.

25 THE CHAIRMAN: What is everyone else's

1 page?

2 MR. SHEPHERD: It would probably be 105,
3 yes. It's section 7.3 of that interrogatory.

4 Q. And this looks to me like you say you
5 do Monte Carlo simulations at each of the two stages of
6 your process but it doesn't say here that you then
7 change them if you don't like the answers.

8 MR. BURKE: A. That's because we already
9 know that this scaling methodology yields a GDP band of
10 the right order. That was determined several years ago
11 and is still the case and that's why we scale by the
12 amount we scale.

13 It certainly must strike people that it's
14 somewhat arbitrary to scale the population standard
15 deviations. The judgment was made and we point out
16 that there is a judgment on, I think it's page 10, at
17 the bottom of Exhibit 10, that the confidence shown in
18 the population forecast is one of the judgmental
19 elements in determining the uncertainty band for the
20 load forecast, and effectively that which is at the
21 point at which we do the scaling.

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...

1 [3:00 p.m.] If we did not do that scaling we would
2 not produce a GDP band that was remotely close to our
3 survey results. So we are obliged to, in fact, do that
4 sort of scaling.

5 Q. I am going to come back to the survey
6 results in a second, but when you scale the standard
7 deviation, which you have done, right, is there a
8 technical basis for doing that? Is there a technical
9 reason why that's necessary aside from the fact that
10 you want to get certain types of results?

11 A. No. It's done because we want to
12 achieve a GDP band that is reasonable.

13 As I have said before, the alternative to
14 this is a totally judgmental approach. I am not
15 familiar with anybody, particularly, who tries to model
16 GDP uncertainty for this sort of exercise. We did it
17 for reasons that I have described, that we have to
18 produce a year by year uncertainty band and we wanted
19 to be able to do it fairly mechanically once we had a
20 system that was calibrated into the right range, and
21 this sort of assumption was what it took.

22 Q. It sounds to me like what you are
23 saying is that you take a look at what the other
24 forecasters tell you, and that is in effect your GDP
25 band, and then you find an equation that matches that.

1 A. Well, it's not as far from that as it
2 might seem, no, but it's not that we see what other
3 people forecast.

4 We specifically ask them what the 10 per
5 cent and 90 per cent points of their long-term view of
6 Ontario GDP was. So, we are asking them, without
7 giving them any feedback on what other people are
8 saying, to give us a long-term forecast bandwidth for
9 GDP, and that is used as a reasonable indicator but it
10 isn't slavishly followed.

11 Our own forecasting people look at that
12 and, in the end, we have come with a factor using a
13 wider bandwidth then that survey result indicates.

14 Q. I am not sure I understand whether
15 you use the results of your model or the results of the
16 external forecasters or some combination.

17 A. Well, given that we have a certain
18 amount of control over the results of the model, it's,
19 you might say, some combination, because if we didn't
20 scale the model, it would not produce a bandwidth that
21 we were happy with. And if we use the survey results
22 we would be narrower than we are now, which concerns
23 our own forecasters because they are not sure they can
24 really deliver a forecast that accurately.

25 Q. Now, when you use the smaller

1 standard deviation, isn't one of the results of that
2 that if your estimate of population growth, which is
3 the exogenous variable was zero, then mathematically
4 the result would be you would be 100 per cent certain
5 of that answer?

6 A. Yes, this is designed to achieve a
7 certain reasonable result. Obviously if we had zero
8 population growth we wouldn't use the same approach.

9 Q. So, do I take it then that it only
10 works at one per cent, it's only correct at one per
11 cent or reliable at one per cent?

12 A. This particular mathematical way is
13 valid in the close neighborhood of the forecasts we are
14 working with. And if the population forecast started
15 to depart significantly from the population forecast
16 and the region around it that we were working with, we
17 would have to do something different.

18 This is a device to achieve a reasonable
19 GDP bandwidth that can be mechanistically simulated for
20 the sorts of purposes that we require GDP bandwidths
21 for. It does not claim to be the only way to do it or
22 the correct way to do it in all circumstances.

23 Q. The way it's designed, it works best
24 at one per cent of your own, of whatever your median
25 is; right?

1 A. Well, it works in the range. I am
2 not sure whether it's only at one per cent, but it's
3 certainly, as you get closer to zero, clearly we
4 wouldn't do the same thing.

5 Q. And presumably as you get closer to
6 two or to three or to four you would also have some
7 concerns about how it worked?

8 A. Well, it would depend on where that
9 took the GDP band. That is, if we were dealing with 3
10 or 4 per cent population growth in Ontario for the next
11 25 years, we would be having GDP forecasts that are,
12 well, typically one-and-a-half to two per cent higher
13 than that, and frankly, at that point I would ask Mr.
14 Rothman what he was doing with his demographic forecast
15 because it wouldn't pass, even the demographic forecast
16 wouldn't pass the reasonableness test, let alone the
17 GDP forecast that results from it.

18 Q. Clear something up then for me. It
19 sounds like as you get farther away from your median,
20 this model gets more and more wrong. At one per cent
21 it's pretty good, at zero per cent it's totally crazy.
22 Somewhere in between it gets worse and worse.

23 A. Well, we had this interesting
24 discussion about the interplay of judgment and
25 quantitative techniques on Thursday. This is certainly

1 a case where if you take a purely quantitative
2 approach, you are going to get yourself into trouble
3 unless you apply some judgment. And this approach does
4 not claim to handle all circumstances.

5 It's objective is to get a reasonable GDP
6 band and one that we can then produce all the glorious
7 numbers that are required for planning purposes in a
8 great amount of detail but is in a reasonable range.
9 If the band is not in a reasonable range, we would
10 change the scaling factor. So that if we started to
11 produce absurd results, we would do something
12 different.

13 Q. Isn't the notion or the essence of
14 bandwidth the notion of variances from the mean? Isn't
15 that what you are doing in bandwidth, is calculating
16 variations from a mean or median?

17 A. What I am trying to do is to estimate
18 a GDP bandwidth and this is the way we have gone about
19 doing it. That is my objective.

20 As we indicated, it's a challenging
21 exercise. We could have done it judgmentally, we could
22 have done it purely with a survey. Because we needed
23 to do it in much more greater detail in all kinds of
24 cases that don't lend themselves well to surveys, we
25 chose to do it this way. But, consider the survey,

1 consider the history of GDP but itself; that is why go
2 to all this trouble to model GDP if you can just use
3 the history of GDP by itself. That turned out to be
4 too narrow a band. Nobody found that credible because
5 it's much narrower than the band we get from the survey
6 and even narrower still than the band we get using this
7 equation.

8 Q. I guess I am having a hard time
9 understanding why you have got this model that as you
10 move to the lower probability futures, if you like, it
11 gets more and more wrong, and yet -- I am not sure why
12 you would have a model at all if what you are relying
13 on is what the other forecasters say.

14 A. The scaling factor is not something
15 that is simulated. The scaling factor is set once and
16 for all. So, it's not as if during simulation somehow
17 we end up in a situation where the uncertainty that
18 measures the scaling factor is set for the median.
19 That's it. It doesn't change. It is not simulated.
20 So, that aspect is not a function of dispersion about
21 the median of population.

22 The only thing that is a function of
23 dispersion about the median of population as far as it
24 pertains to load -- well, no, that's if you carry
25 through directly without looking at GDP.

1 Q. Do I understand correctly then that
2 the way you got to this scaling factor is you said how
3 wide do I want this bandwidth, and whatever the right
4 number was, that's what you used?

5 A. The bandwidth for GDP is ultimately
6 judgmental. It is a range forecast against various
7 sort of reasonableness tests of what a GDP band should
8 look like, yes.

9 Q. So your answer to my question is yes?

10 A. Well, not exactly what you said, what
11 I said.

12 Q. All right. Let's go to the the next
13 issue with respect to your model structure. I am going
14 to ask you to turn up Exhibit 97.

15 THE CHAIRMAN: 97?

16 MR. SHEPHERD: 97. It's entitled "Notes
17 on Ontario Hydro's Forecasting Activities", the author
18 is Dr. Christopher Chapman.

19 THE CHAIRMAN: Okay. I have got it
20 somewhere. I know I saw it.

21 MR. BURKE: Yes, I have that.

22 MR. SHEPHERD: Q. It might be convenient
23 if you also turn up Exhibit 130 which is Dr. de Bever's
24 short paper on the same issue.

25 MR. BURKE: A. Yes, I have both of

1 those.

2 Q. Dr. Chapman has, in a very polite
3 scientific way, raised serious doubts about how your
4 model is structured in fact, your uncertainty model is
5 structured in fact. He says it's just unsound. The
6 math is wrong. Dr. de Bever has referred to it as
7 structural unsound, called it functionally unsuitable
8 for the use to which you are putting it.

9 Maybe we could short circuit this a
10 little bit by asking you, in light of these comments,
11 do you agree with those criticisms?

12 A. No, I think they are invalid.

13 Q. Can you tell us why?

14 A. There are two points that I think Dr.
15 Chapman wants to make, one concerns the matter we have
16 been discussing up to now, which is the scaling of the
17 standard error of population. And on page 4 of his
18 material he generates a bandwidth for load using the
19 standard error that he perceives to be more
20 appropriate.

21 Implicit in this standard error is a
22 growth rate, a GDP band at the 80 per cent level that
23 ranges from 1 per cent to 6 per cent approximately.
24 Our survey indicates that the results are in the range
25 perhaps 1.7 to 3.6 of that order for a 10-year period.

1 In fact, the 1990 survey to 2000 indicates, I believe -
2 I will just turn it up here - 2.3.

3 THE CHAIRMAN: Are you reading from his
4 paper? Those figures don't seem to leap out at me from
5 page 4.

6 MR. BURKE: No. On page 4 what he has is
7 a load band.

8 MS. PATTERSON: This is Chapman?

9 THE CHAIRMAN: Where is that?

10 MR. SHEPHERD: Exhibit 97.

11 THE CHAIRMAN: Yes, load band. Yes, I
12 see that.

13 MR. BURKE: I am suggesting that because
14 Dr. Chapman did not do any sanity checks on his GDP
15 band on the way, he has implicitly generated an 80 per
16 cent GDP band, that is 1 per cent to 6 per cent for the
17 next 10 years, and that our survey of experts done
18 last --

19 THE CHAIRMAN: Those are calculations you
20 have made from this?

21 MR. BURKE: Yes, from these numbers,
22 that's right.

23 THE CHAIRMAN: That's what I am having
24 trouble following.

25 MR. BURKE: I have used the upper and

1 lower levels, looked at the growth rates versus '89,
2 made the simple assumption that roughly speaking load
3 band would be slightly wider than the GDP band and
4 said, for the very reasons that we go not use the raw
5 standard error, Dr. Chapman has produced a result that
6 is clearly implausible. He has produced a band that is
7 much much wider than expert opinion of an 80 per cent
8 band for GDP. 2.3 to 3.6 is what our external load
9 forecast advisory people said was reasonable.

10 THE CHAIRMAN: You are going pretty fast.
11 2.3 to 3.6?

12 MR. BURKE: Is an 80 per cent confidence
13 band for GDP according to a May 1990 external economic
14 advisory committee survey of its fifteen members.

15 THE CHAIRMAN: What do you say Dr.
16 Chapman's is?

17 MR. BURKE: Roughly 1 per cent to 6 per
18 cent.

19 THE CHAIRMAN: 1 to 6.

20 MR. BURKE: Yes, much much wider.

21 And I am making the statement that the
22 reason we scaled was to avoid such a wide band in the
23 first place. We obviously knew what we would get if we
24 did not scale and we rejected that as unreasonable.

25 MR. SHEPHERD: Q. Let me pursue that for

1 a moment, Mr. Burke. Your original bandwidth was
2 14,000 megawatts, right, in capacity?

3 MR. BURKE: A. which original bandwidth?

4 Q. Thirteen-nine? Your 1990 bandwidth
5 was thirteen-nine?

6 A. For when?

7 Q. For 2015. Sorry, this is 2000, is
8 it?

9 Now, you have in fact changed yours,
10 right? You changed your load forecast bandwidth
11 substantially; haven't you?

12 A. Yes, I have, yes, because of some
13 properties beyond 2009. It doesn't change before 2009.

14 Q. So, does that mean that you didn't do
15 a sanity check either?

16 A. I have admitted to my embarrassment
17 on my stand that I produced a result that I
18 judgmentally would not wish to have produced and
19 therefore I have corrected it.

20 Q. Have you gone back to the implicit
21 GDP that would underlie that --

22 A. Yes, I have that.

23 Q. And what is the new GDP band?

24 A. The new GDP band to 2015 now --

25 Is that what you are interested in?

1 Q. It doesn't matter.

2 A. --is 1.7 to 3.6 per cent.

3 Q. As compared to what? What was your
4 previous one?

5 A. Two to 3.3. So, it is about 0.3
6 added and 0.3 subtracted on either end of the
7 distribution.

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1 [3:15 p.m.] This is relative to several per cent
2 difference between ourselves and Dr. Chapman --

3 Q. Yes. Dr. Chapman has argued that.

4 MR. B. CAMPBELL: I'm not sure Mr. Burke
5 is finished his answer. I had down that he was going
6 to speak to two matters. I'm not clear whether he
7 spoke to both of them.

8 MR. SHEPHERD: I'm apologize. I lost
9 track.

10 MR. B. CAMPBELL: Okay.

11 MR. SHEPHERD: Go ahead, please.

12 MR. BURKE: Thank you, Mr. Campbell. The
13 second point that Dr. Chapman wants to make concerns
14 the forecasting properties of a system we don't use for
15 forecasting. We have two equations. We use one to
16 develop a GDP band and we use the second to translate
17 the GDP band into load.

18 And so what Dr. Chapman demonstrates is
19 that if you extrapolate quite extensively beyond the
20 range of our forecast both in terms of time and in
21 terms of the magnitudes of the driving variables, you
22 can result in what Dr. de Bever has shown as a
23 knife-edge property to the forecasting function, which
24 would, if we were about 25 years from now doing this
25 same exercise, result in the fact probably that that

1 equation would no longer track the median forecast that
2 we prepare using econometric and end use methods. And
3 we would reject the equation at that point.

4 But I'd like to emphasize it would take
5 roughly that long. If you turn up Dr. de Bever's
6 evidence, he produces a very useful plot at the last
7 page which --

8 MR. B. CAMPBELL: Sorry. What's the
9 exhibit number?

10 THE CHAIRMAN: 130.

11 MR. BURKE: 130. Which shows that --
12 just to put things into context, the population of
13 Ontario is something less than 10-million today, and
14 we're forecasting in our median case a population of
15 12.6-million.

16 If we use our standard error, the upper
17 bound corresponds to 13.4-million. Sorry, about
18 14-million. If we use Dr. Chapman's upper bound, I
19 think we're around 15-million.

20 But that means that the only point that
21 really is relevant about this analysis is the extent to
22 which, in simulating large values of population on the
23 tails of the distribution in 2015, are we likely to run
24 into values that are so large that they go beyond the
25 knife edge here.

1 And so our simulation of the band width
2 for 2015 is somehow influenced by the properties of
3 this equation. And my assertion is it is not, that the
4 knife-edge properties were not going to run into for
5 about another 25 years. Population grows at about a
6 million a decade in Ontario. The knife-edge is at
7 20-million. We could properly be simulating 25 years
8 from now and at the 80 per cent or 90 per cent points,
9 not have values that are beyond the knife edge.

10 Essentially, I disagree with Dr.
11 Chapman's view that because - and Dr. de Bever's - that
12 because this equation, which is a quadratic, has
13 undesirable properties once the population exceeds 20
14 million, that is invalid it to use it the rage of 13
15 million.

16 There is a lot of experience of using
17 quadratic equations to approximate things in a useful
18 range. This exercise is one of extrapolation well
19 beyond the useful range that we're putting this
20 equation to, and I put it to you that if in fact we
21 ever got to that point, it would no longer track the
22 load forecast. And so it would be rejected as the
23 equation to use to derive the band width.

24 We have other we equations that don't
25 have the quadratic property. They result in similar

1 band widths. So, I feel any results are robust in that
2 sense. It's not a function of the equation type. I
3 think this is quantitative analysis without judgment.

4 MR. SHEPHERD: Q. I take it then that
5 you're saying that sooner or later your equation is, in
6 fact, wrong; it's just that numbers that it has to be
7 wrong at are not within the range that you're
8 expecting?

9 MR. BURKE: A. Yes.

10 Q. Now, when you use an equation like
11 this, does it sort of suddenly become wrong or does --

12 A. Well, I think you can see the point
13 at which it suddenly becomes wrong. It's quite clear
14 in this picture.

15 THE CHAIRMAN: Again, which picture is it
16 you're looking at?

17 MR. BURKE: It's the third page of Dr. de
18 Bever's Exhibit 130. It shows that as population gets
19 to about 20-million, it has some intuitively
20 undesirable impacts on the load results, and -- but
21 that in the range 13-million to -- I think the highest
22 number we'd really run into is 16-million or so in a
23 simulation like the one we're doing for the year 2015.
24 This equation is very linear. There isn't much that's
25 happening that's particularly exciting.

1 THE CHAIRMAN: Again, just to be
2 absolutely clear, is it graph No. 1 you're looking at?

3 MR. SHEPHERD: Graph No. 2?

4 MR. BURKE: No. I think it's number 2.

5 THE CHAIRMAN: Graph No. 2?

6 MR. BURKE: Yes. I'm suggesting that in
7 the region of 13-million, plus 2- or 3-million, the
8 equation is extremely linear, unexciting, doesn't do
9 anything unstable and is quite adequate for the purpose
10 to which it is put.

11 MR. SHEPHERD: Q. Well, if what you want
12 is an equation that draws a straight line, why does
13 your equation draw a curve line? I don't understand
14 that.

15 MR. BURKE: A. Because it has to track a
16 forecast that has a declining elasticity for load. It
17 is a variable elasticity model. The variability comes
18 in through the second term on GDP-squared, and that is
19 what causes this model to actually replicate our load
20 forecast where most single equation models would not.

21 And in the region to 2015 that we're
22 working with, it does it extremely well, as I pointed
23 out on page 106, I guess, of the 1990 load forecasts.
24 And that is what we intended to do, and it performs
25 very well in the region that it is supposed to operate

1 in.

2 Q. So, the only criteria then that you
3 would decide tht you like this equation is that it
4 tracks your median load forecasts, which you've done
5 more comprehensively?

6 A. Parsimoniously in terms of variables
7 that we can try to estimate the uncertainty of; that
8 is, you -- in estimating uncertainty, one has the
9 problem of also estimating the uncertainty in
10 explanatory variables.

11 So, parsimony is a virtue, and we've
12 picked the major driver. We've picked the only
13 equation with the major driver that tracks the load
14 forecast. In fact, the class of possible candidates
15 for this equation is very small, and we can get
16 equations that are nearly as good with electricity
17 price and gas prices in them, and they are given in
18 Exhibit 10. And also in the background report, we have
19 a background report on the Monte Carlo simulation with
20 another one with that equation with price and price
21 variables in it.

22 The price variables have the effect of
23 causing the forecast to show decreasing elasticity over
24 time, and they produce a band which is even narrower
25 than the band that we have with this approach. So we

1 rejected it as too narrow.

2 Q. I guess the difficulty I'm having is
3 that you say, "Take a look at population within the
4 range that you're expecting over the forecast period,"
5 and it looks to me like a straight line. It looks to
6 me like, in fact, some of your variables are offsetting
7 other variables to produce ultimately a straight line.
8 Isn't that about right?

9 A. Well, I think this is one of these
10 things where magnifying the scale wouldn't hurt. But
11 it's not a straight line. It curves slightly. It
12 curves the amount of our forecast, which is 15 per cent
13 reduction over 25 years.

14 Q. So the nice thing about this equation
15 then is that it produces a reliable result. It does
16 what you want it to do, produces a result that you
17 like?

18 A. I think we're quite clear that what
19 the objectives are of the process of estimating the
20 uncertainty associated with the median load forecast.
21 It is important that the equation track the median
22 forecast. It does that. It's important that it do it
23 parsimoniously. It does that.

24 We then have to estimate GDP uncertainty.
25 We do that separately. We don't run the two together

1 just to see what numbers we can generate with extreme
2 values.

3 The range of the values here for which
4 stability exists is well beyond what we're likely to
5 run into in Ontario in the year 2015. As I say, I
6 think I could use this for 25 years and not run into a
7 problem.

8 I doubt very much I will use the same
9 approach for the next 25 years, but this certainly is a
10 test of a quadratic well outside the range that is
11 relevant for the purpose of this hearing.

12 Q. And if it you did use it for the next
13 25 years, could we expect it to produce the same sort
14 of bandwidth that it produced last year?

15 A. Well --

16 Q. And to be just as wrong?

17 A. Pardon?

18 Q. And to be just as wrong?

19 A. I don't understand your point.

20 Q. Well --

21 A. What's wrong?

22 Q. Didn't this equation produce a
23 bandwidth of 13,900 megawatts that you told us last
24 Wednesday was totally wrong? Isn't that right?

25 A. What I said was that it had a

1 property a beyond 2009 that it narrowed, and,
2 effectively, it was the GDP band that was narrowing,
3 and, effectively, from our perspective, we didn't scale
4 it quite right to produce a GDP band that is
5 judgmentally reasonable. That should have been
6 corrected. I have corrected it.

7 It results in a GDP band which is wider
8 than the survey throughout the period instead of
9 converging to the survey by the end of the period.

10 I'm now satisfied that the GDP band is
11 reasonable. It produces a load band that is
12 reasonable. I have not changed the load equation.

13 MR. SHEPHERD: Mr. Chairman, this may be
14 an appropriate time to take a break.

15 THE CHAIRMAN: Right. After the break.

16 THE REGISTRAR: 15 minute break.

17 ---Recess at 3:30 p.m.

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1 ---On resuming at 3:47 p.m.

2 THE REGISTRAR: This hearing is again in
3 session. Please be seated.

4 THE CHAIRMAN: Mr. Shepherd.

5 MR. SHEPHERD: Mr. Chairman, my experts
6 this morning predicted that I would not be able to
7 finish by the end of the day. I think at this point it
8 is probably nip and tuck. I am going to try.

9 THE CHAIRMAN: All right.

10 MR. SHEPHERD: Q. Let me follow up the
11 last point just with a couple of --

12 THE CHAIRMAN: I think, I'm not the only
13 one, we are having a little difficulty hearing you this
14 afternoon. I don't know whether your mike is working
15 or if you are too far away from it.

16 MR. SHEPHERD: I am probably mumbling,
17 Mr. Chairman. Especially after that last interchange,
18 I may be mumbling more.

19 Q. Mr. Burke, the problem you had last
20 Wednesday was from the year 2009 onwards; right? There
21 was no problem in the numbers up to the year 2009?

22 MR. BURKE: A. That's correct.

23 Q. But it is the same equation that
24 projects the bandwidth for each year; doesn't it?

25 A. The GDP equation is the same for each

1 year; and once the GDP bandwidth is determined, the
2 load equation is certainly the same. I guess the issue
3 is: Did the GDP band satisfy a reasonableness test?
4 And one of the criteria which seems to say it did not
5 was that it started to actually become narrower beyond
6 the year 2009 in absolute terms.

7 This is a combination of the empirical
8 reduction in standard deviation population as you move
9 from 20 years out to 25 years out and the scaling in
10 the sense that the demographic forecast also loses
11 about 10 per cent of its growth rate in the 2010 to
12 2015 period.

13 So that effectively, the scaling
14 procedure combined with the demographic standard
15 deviations resulted in the band narrowing beyond 2009.
16 The band for GDP was pretty well constant from about
17 2003, 2004 through to 2009, and then it started to
18 narrow. And essentially it was my judgment that it
19 should not do so. It was not my intent that it do so,
20 so I made the change.

21 Q. You don't use a different scaling
22 factor for each year; do you?

23 A. The procedure for scaling we have set
24 and for all the years up to 2009 it produced reasonable
25 results. But beyond 2009 -- it is not just the scaling

1 but also whether one believes that the standard
2 deviation of population really is going to pinch in as
3 much as the history would suggest it does.

4 Q. So, up to 2009 everything is fine;
5 right?

6 A. Well, up to 2009, the GDP band
7 satisfies our reasonableness checks. One cannot be
8 precise about what the GDP band should be exactly.
9 Clearly it exceeds the survey by an amount, it varies,
10 but it seems reasonable up to 2009.

11 Q. And then in the year 2009 suddenly it
12 falls off the table? Suddenly it's wrong.

13 A. No. It increasingly falls off the
14 table between 2009 and 2015.

15 Q. But do I understand it's correct up
16 to 2009? You are happy.

17 A. I am satisfied that it is reasonable
18 to 2009.

19 Q. But it is the same equation, isn't
20 it, before 2009 and after?

21 A. The equation is the same, yes, but
22 the equation is not what is determining the -- I mean
23 it determines the translation of the population
24 standard deviation into the GDP standard deviation
25 effectively, but it is the standard deviation

1 population itself that matters most in all of this
2 equation.

3 THE CHAIRMAN: I think, Mr. Shepherd -
4 excuse me, Mr. Burke - Mr. Burke has given this
5 explanation about three times. I mean, you may not
6 accept it, it may not be right, but I think he has gone
7 over it at least three times that I can think of, this
8 particular explanation of why he did what he did and
9 all the matters he just spent the last five minutes on.

10 MR. SHEPHERD: Mr. Chairman, I was
11 actually driving at a different point, although I
12 understand I am covering previous ground.

13 THE CHAIRMAN: All right.

14 MR. SHEPHERD: Q. Mr. Burke, when you
15 use an equation to translate one variable into another,
16 the equation is the same regardless of where on the
17 line you are; isn't it? The equation doesn't change
18 over time. It is still the same functional
19 relationship between the two variables?

20 MR. BURKE: A. Well, it's the same
21 equation but the property of both of the equations is
22 that the elasticity changes over time; that is, what a
23 proportionate change in one explanatory variable does
24 to a proportionate change in the dependent variable
25 changes. It's a function of the scale of GDP or the

1 scale of population.

2 Q. Let me drive at this a different way.
3 When you have an equation that explains load in terms
4 of population for example --

5 A. Which I don't.

6 Q. Well, load in terms of GDP, which you
7 do; right?

8 A. Yes.

9 Q. Whatever your GDP number, the
10 mathematical relationship between load and GDP is
11 identical; isn't that correct?

12 A. I guess maybe I am not quite sure
13 what you mean by the mathematical relationship.

14 Q. When you have an equation load equals
15 x times GDP - I am oversimplifying - but let's say x
16 times GDP, whenever you change GDP, that produces a
17 mathematically identical change in load no matter what
18 GDP is; correct?

19 A. Well, that is a property of a linear
20 system but it is not a property of a quadratic system.

21 Q. So your equation changes then as the
22 GDP number changes?

23 A. The co-efficient is the same, but
24 because GDP is there twice, once as a linear term and
25 once as a term of degree 2, the effect is that the

1 relationship between GDP and load changes over time as
2 specified by the equation. But it's not the same
3 relationship for -- that is just the point of the
4 equation. The relationship does change over time, it
5 is not the same.

6 Maybe I can help here. I believe that
7 the elasticity in the load equation is something around
8 1 or slightly higher at the beginning of the period and
9 it drops to about 0.85 or slightly less by 2010, 2015,
10 so that a given value of GDP does not produce the same
11 load as GDP changes over time.

12 And that is a property of a forecast as
13 well. The median forecast that we arrive at with the
14 end use econometric models does not have the property
15 that a given value of GDP will necessarily produce the
16 same value of load right throughout the forecast
17 period.

18 Q. I am going to ask you to look at
19 graph 2 of Exhibit 130. Let's just take for argument's
20 sake a population of 20,000.

21 A. You mean 20-million?

22 Q. 20-million, sorry. And compare that
23 to the population of 12-million. Now, am I correct in
24 understanding that your model describes the shape of
25 this line exactly the same way at 20-million as it does

1 at 12-million?

2 A. I have to admit I do not understand
3 your question.

4 Q. Doesn't a functional equation
5 describe the shape of the line?

6 A. We have two equations in this graph:
7 the population equation and the load equation -- sorry,
8 the GDP equation and the load equation, and they are
9 strung together to produce this graph.

10 Q. I have to admit I am lost
11 sufficiently in the math that I can't pursue this any
12 further. Let me go back to another area that I think
13 maybe I will have an easier time with.

14 I am going to show you, if I can find it,
15 I think its page 22, the last page of the overheads.
16 You will be pleased to know that I have skipped over
17 all of those other overheads and won't be coming back
18 to them.

19 THE CHAIRMAN: I beg your pardon. You
20 won't be coming back to them?

21 MR. SHEPHERD: I will not be coming back
22 to them.

23 THE CHAIRMAN: That just raises a
24 procedural -- should it then remain as part of the
25 exhibit or should it be removed from the exhibit?

1 MR. SHEPHERD: I am happy to take them
2 out. It doesn't matter.

3 THE CHAIRMAN: Just as a matter of form,
4 I guess that we haven't been precisely policing all the
5 overheads, but I think most of them have been used up
6 to now. But if you are not going to use them, then I
7 suppose they shouldn't be there.

8 MR. SHEPHERD: They are --

9 THE CHAIRMAN: Or maybe they should be.
10 I have no strong views one way or the other.

11 MR. SHEPHERD: No, Mr. Chairman, I think
12 I agree with you. They are numbers 13 through 21, the
13 ones that I have not used.

14 THE CHAIRMAN: I guess they should be
15 just deleted. So that will be pages 13 through 21 of
16 Exhibit 126 will be removed.

17 THE REGISTRAR: Yes, Mr. Chairman.

18 MR. SHEPHERD: I was planning to go
19 through the math in detail but I now realize that I
20 will never understand my own questions.

21 Q. Now, when we are talking about
22 uncertainty, we are not talking just about sort of a
23 single concept, are we? There is a whole bunch of
24 different types of uncertainty that arise in
25 forecasting; isn't that correct?

1 MR. BURKE: A. I think there are
2 different sources of uncertainty.

3 Q. Yes.

4 A. I don't know I would use the word
5 "types" particularly.

6 Q. Okay, sources.

7 Now I have prepared a list of ones we
8 could think of and I wonder if you could just take a
9 look at this list and tell us whether there is anything
10 on this list that should not be considered a normal
11 source of uncertainty, or, alternatively, if there is
12 anything missing on this list.

13 A. Well, the latter point is certainly
14 tall-orderd one -- one moment, please.

15 ---Discussion off the record.

16 MR. BURKE: You have got a variety of
17 sources listed here. Typically when people look at
18 sources of uncertainty in forecasting, they talk about
19 uncertainty in the data, uncertainty in the
20 specification of the model, uncertainty in the driving
21 variables or explanatory variables of the model, and
22 then a broader class of uncertainty to do with
23 structure of the economy and the context in which the
24 whole exercise is being undertaken.

25 I think what is on your page is

1 fundamental changes that may make building an equation
2 about the past sort of not relevant for the future that
3 it is being used to forecast for.

4 And typically one can try to quantify the
5 first three kinds. But also one finds oneself saying
6 things like we have been saying that some of these are
7 fundamental changes in structure, the way the economy
8 works, what the rules are, that sort of thing, those
9 sorts of things one can't quantify very well.

10 Because they haven't happened, they tend
11 to be relegated to this class that we have called "low
12 probability, high impact" contingencies, which can
13 affect the forecasts. And then the problem comes: How
14 do you deal with those given that you have said that
15 individually they are of low probability?

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1 [4:02 p.m.] MR. SHEPHERD: Q. Let me come back to
2 that, okay? I take your point.

3 MR. BURKE: A. But looking at the first
4 three kinds, I believe that the first five look like
5 they refer to the data, roughly speaking, and then
6 there are several that refer to how the model is
7 specified, and then I guess I am trying to think where
8 randomness goes in a source of uncertainty because I
9 have a feeling it is not a source of uncertainty, it is
10 uncertainty.

11 THE CHAIRMAN: Perhaps could you explain
12 to me what you understand randomness to be?

13 MR. BURKE: Well, randomness is a
14 property of data that suggests that there is no pattern
15 to the data. One talks of a random walk which suggests
16 that from one point to the next there is no basis on
17 which to predict where the data will move next. No
18 model seems to understand it.

19 A good example used to be, I am not sure
20 whether it still is, the stock market. Individual
21 stocks used to be considered a random walk in that it
22 was not possible to model how they would move from one
23 day to the next, and if you could, then could you make
24 a lot money and it wouldn't really work that way in
25 practice, everybody would do it, and so on.

1 But it is this property of being without
2 structure, without pattern. Is that...

3 THE CHAIRMAN: That is fine. Thank you
4 you.

5 MR. BURKE: I would say I am not sure
6 whether economic judgments and political policy --
7 well, economic judgments may refer to No. 8. It might
8 refer to model specification, but if it doesn't then I
9 would hazard that 8 through to 16 seem to be different
10 kinds of structural ways of looking at what I have
11 called structural uncertainties. It's uncertainties
12 that are not implicit in the historical data, as least
13 as we discussed philosophically on Thursday, it's
14 probably there somewhere but only by hindsight would
15 you realize it, and we are not focusing on it today and
16 so we do not pick up some of these changes in the
17 forecast.

18 MR. SHEPHERD: Q. There is a difference,
19 isn't there, between the many judgments you do make in
20 forecasting which are sort of judgments within a
21 reasonable future, and fundamental change which you say
22 you just can't deal with, there is no way of dealing
23 with it; isn't that right?

24 MR. BURKE: A. No way of being confident
25 quantitatively in the way you deal with it.

1 Q. And there is different types of
2 uncertainty depending on whether you are talking about
3 fundamental change or you are talking about the
4 day-to-day judgments you are making?

5 A. Most of the judgments that we have
6 been talking, at least that I have been talking about,
7 have referred to the first three types or sources of
8 uncertainty.

9 Q. Yes. You have problems with all of
10 these things in uncertainty, in your uncertainty model,
11 don't you; that is to say, all of these types of
12 uncertainty one way or another come into your
13 forecasting.

14 A. Yes. I guess what I am reacting to
15 is by giving a whole bunch of different names to the
16 same sort of thing, I am not sure whether you aren't
17 making it sound bigger than it is.

18 I mean, data uncertainty covers a
19 multitude of sins and you have got some of them here,
20 but the fact is that you can't absolutely rely on your
21 data or you don't have all the data that you want, that
22 sort of thing.

23 Model specification uncertainties, we
24 have discussed the sorts of things that constrain model
25 specification. Model specification can be constrained

1 by the variables for which you have forecasting
2 capability. That is, you can only include explanatory
3 variables for which you may have a source of forecast,
4 and so that may offer a constraint on model
5 specification, or for which data is collected. There
6 may be variables that you would love to have in an
7 equation but no one has collected the data. But it's a
8 general class of specification uncertainties.

9 Q. So you can have a situation, for
10 example, where there simply is no data in an area or
11 you can have a situation where you have data but you
12 don't think it's reliable data, isn't that correct?

13 A. Yes. Telling whether your data is
14 reliable or not can sometimes be difficult.

15 Q. Wasn't there testimony at one
16 point -- I am trying to find the reference. I seem to
17 recall Dr. Buja-Bijunas saying at some point that there
18 was data for a particular thing for eight years, that
19 when you looked at it it didn't look like it was good
20 data, not well collected, so you didn't use it.

21 A. Well, it may have been myself
22 referring to commercial natural gas data, that the
23 feedback from the gas companies in Ontario was that the
24 Statistics Canada data for natural gas consumption in
25 the commercial sector did not make sense to them. So

1 there is one way of telling whether data is reliable.
2 But it comes in that case to having an alternative
3 source of information, and quite often you don't.

4 Q. Now, let me deal with a couple of
5 these, just as examples. Look at underlying
6 correlations in the data. That's, for example,
7 elasticities, right? You could get your elasticities
8 wrong or you could have some uncertainty about the
9 elasticities between individual variables?

10 A. Well, I don't know what the intent of
11 the word is "underlying" is here. If the intent is
12 that there are correlations you haven't captured, then
13 it's not a question of getting elasticities wrong; you
14 just haven't specified the model to capture that
15 correlation.

16 If you are saying you did specify the
17 model correctly but then there is uncertainty in the
18 estimation of that correlation, certainly that's
19 correct.

20 Q. Either way it's a particular type
21 of -- there is an uncertainty there, a potential for
22 error there?

23 A. Yes. And I would add that in our
24 uncertainty methodology, that sort of uncertainty is
25 captured by the standard error on the coefficients of

1 the variables in each equation.

2 Q. Now, let me just look at an example.
3 Somebody - I don't remember who it was - filed Exhibit
4 112, which was your 1987 estimate of residential
5 own-price elasticities, and as I recall, it was minus
6 .95; is that right?

7 A. My recollection is that applied to
8 the residential sector.

9 Q. Yes. And am I correct in
10 understanding that in 1989 you changed that to minus
11 .78?

12 A. Yes.

13 Q. And am I also correct that you now
14 think its minus .51?

15 A. Yes. And I think I explained to
16 Energy Probe, I believe, why we thought the first major
17 change had occurred. In fact, both changes are largely
18 due to -- because I think there was in each year one
19 time frame removed from each of the two equations in
20 the residential sector, and the effect of time trends
21 was to distort the elasticities, and it's not the sort
22 of thing I would hope continue to happen; that is, we
23 have improved the estimate of the equations for the
24 residential sector and I would hope it's a fairly
25 stable specification given the data that we have

1 available.

2 If new data sets become available, we
3 might be more adventurous in specifications, but given
4 the data set which is available, the major cause of the
5 change; that is, having time trends in the equations
6 and then taking them out sequentially as it turned out,
7 explains in my mind why the elasticity changes, and I
8 feel that the value we have now is more indicative of
9 the correct price elasticity in that previously other
10 non-price effects were loaded on to the price variable.

11 Q. Now, of course hindsight is 20/20,
12 but I guess it's fair to say then that your minus .95
13 number in '87, now we see from hindsight had a lot more
14 uncertainty in it than your current number.

15 A. Well, we are not comparing apples and
16 apples here. They are two different equations and that
17 equation had a time trend in it. The forecast from
18 these two equations was not perhaps as different as the
19 change in elasticity might imply.

20 Effectively, the time trend was
21 offsetting the elasticity and so the forecasts really
22 didn't differ that much.

23 Q. It's like a double error?

24 A. Well, it comes to why we have a time
25 trend in the equation in the first place.

1 Q. So, had you estimated a probability
2 distribution of that minus .95 number, say, you might
3 have had the same sort of bandwidth on that that you
4 would if you estimated today on minus .51? Do I
5 understand you to be saying that?

6 A. Well, I am not quite sure what we are
7 trying to get a bandwidth for. If we are trying to
8 say, what was the standard error of that coefficient--

9 Q. Yes.

10 A. --I don't know how they would compare
11 in the two years. But I presume both were significant
12 and therefore -- in fact, in this system there is two
13 coefficients that didn't need to be looked at to get
14 the price elasticity.

15 Q. Is it a factor in your answer that we
16 know today, or we think we know today, that the minus
17 .95 was pretty wildly wrong?

18 A. Well, okay, if the issue is what is
19 the price response of the equation, then you might say
20 it's wrong.

21 The issue for us at the time was getting
22 the equation to forecast reasonably, and we had to deal
23 with an issue about the price forecasts that we were
24 working with at the time and we introduced the time
25 trend into the equation to help us compensate for what

1 we believed were unrealistic price forecasts at the
2 time.

3 It is not, from my perspective, a clean
4 econometric alternative. It is certainly not the case
5 that if we used the same specification today two years
6 ago that we would get anything like .95. The data has
7 not changed that much in two years. What has changed
8 is our forecasting objective, which was to produce an
9 equation several years ago that allowed us to not have
10 what we believe was unrealistically high increases in
11 residential load associated with price changes that
12 were then forecasted at the time, and in that sense it
13 was quite a manipulative exercise that underlaid that
14 equation several years ago.

15 We don't have the time trends in the
16 model now but I wouldn't want to draw inferences what
17 the uncertainty was from a purely statistical point of
18 view and how that's change in two years. There is much
19 more going in the case of that change in elasticity.

20 Q. Let me deal then with another of
21 these areas, the lack of data in relevant areas. You
22 testified I guess a number of times - "you"
23 collectively you - that there are some areas where you
24 just don't have data. That's a problem that you have
25 to deal with fairly regularly; right?

1 A. Yes.

2 Q. What do you do?

3 A. Well, certainly in the econometric
4 modelling exercise, econometricians are in search of
5 proxies, things that might have the same statistical
6 properties as the missing data that one can find and
7 can use, that sort of thing.

8 Dr. Buja-Bijunas may have some comments
9 as to what happens in end-use modelling when data is
10 missing.

11 Q. Just let me take an example. You
12 testified that you don't have sufficient information on
13 the impact of government programs on load to be able to
14 relate the two; isn't that right?

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1 [4:16 p.m.] A. Well, it's not clear one would ever
2 be able to define an economic variable to represent the
3 impact of government programs.

4 I mean, the sorts of data we're dealing
5 with would be things like expenditures on a particular
6 kind of program and hoping to relate those sorts of
7 expenditures to an impact on load. We could try that
8 at some point in the future when that sort of data
9 becomes available, but many programs perhaps don't lend
10 themselves to that.

11 Q. I'm not being critical.

12 A. Like standards, for instance. If
13 that's a government program, then there may not be any
14 dollars expended by the government to tag that to. So
15 you have to use other ways of estimating impact.
16 That's one of the reasons that end-use models are so
17 important for forecasting because they can look at the
18 details and be used to assess implications of specific
19 standards or programs. You wouldn't really try to do
20 that econometrically.

21 Q. Just to follow that example, if, in
22 fact, government programs did have a very high
23 correlation to load - just hypothesize that for a
24 moment - and you had no way of determining that
25 correlation from data, then absent another variable

1 that proxies government programs, you've created a type
2 of uncertainty, haven't you, in which your load
3 forecast is responding to something that you haven't
4 considered?

5 A. In an econometric forecast, one has
6 to consider whether all of the implicit trends in the
7 variables that one is using as explanatory variables
8 are expected to continue into the future or not. If
9 you stick with your econometric specification and you
10 don't judgmentally adjust the forecast that comes out,
11 then, effectively, you are saying all of the things
12 that are implicit that may have had the same growth
13 pattern over the years as the explanatory variables,
14 will continue to have that pattern in future.

15 That's one of the reasons why having
16 simpler models ten or fifteen years ago may have led to
17 different price elasticities than we get today, that
18 implicit in the estimate of coefficient of price - and
19 also GDP, for that matter - were things that were
20 changing other than, strictly speaking, GDP and price,
21 which happened to have the same sort of patterns
22 historically as GDP and price.

23 But then they started to change, and
24 those changes have caused the forecast not to be
25 correct. And as a result, people have tended to

1 disaggregate forecasts more and more to break out the
2 components.

3 And that has led to perhaps a different
4 impact on these coefficients. There are other things
5 in the equations, other explanatory variables, being
6 considered than ten or fifteen years ago.

7 Q. Coming back to the government
8 programs examples, I take it that that's one of the
9 advantages of end-use models then is that they will
10 tend to pick that sort of thing up that you can't
11 project econometrically?

12 A. Well, I wouldn't say they tend to
13 pick it up.

14 Q. That type of model.

15 A. The model is able to represent those
16 judgments explicitly, whereas it is very difficult to
17 stick them into an econometric forecast.

18 Q. But the only way it's different is,
19 that, in fact, you make a positive judgment tht you'll
20 include some sort of factor for a program or a
21 standard?

22 A. Yes, I think you have to make a
23 positive judgment. And that's why we've said when we
24 don't have specific information, it's very difficult to
25 make a positive judgment as to what the precise impact

1 will be.

2 Q. You have to do something, but you
3 have not much to work on?

4 A. Yes.

5 Q. You also have a source of uncertainty
6 if there's a relevant factor or some driving variable
7 underlying the data that you haven't identified; you
8 just don't know it's causing a result. Is that right?

9 Let me give you an example. Suppose as a
10 matter of fact there's a direct correlation between
11 load and frequency of billing, and you just don't know
12 it's there. It's somewhere underneath the data and you
13 don't know whether it's there. If you miss that,
14 that's going to tend to cause error in your forecast,
15 isn't it?

16 A. Well, two steps here. It would cause
17 an error in the forecast if the trend in the frequency
18 of billing changed. That is, we are modelling all of
19 the variation in load with a series of explanatory
20 variables, and one way or another it's being captured.
21 The question is: Is it reasonable to expect that the
22 trend in that particular variable will change at some
23 point dramatically? In which case that's when it will
24 show that it was part of the cause of a particular
25 trend and also then, as it changes, will cause a change

1 in trend that is not explicitly in the model.

2 That's what I call a specification error,
3 my second kind of error. That is, the model doesn't
4 have all or the correct variables, explanatory
5 variables, in it. And that may be limited, as I said
6 earlier, by the data that is available.

7 Q. So, let's just take that example one
8 step further. If, in fact, as a matter of human
9 behavior it is true that a change to, let's say, weekly
10 billing would produce a specific reduction in load and
11 you haven't identified that, then that creates an
12 uncertainty in your forecast, doesn't it?

13 A. Yes, it does. An unquantifiable one.

14 Q. An unquantifiable one. You were
15 talking about randomness a minute ago. When you
16 testified as to load factor, you said one of your
17 problems is that there's no discernible pattern in the
18 past data. Is that true?

19 A. What I said was from the early '70s
20 to today, it seemed to be a pretty random series for
21 the load factor, yes.

22 Q. So in that circumstance you just have
23 to pick a number; right? You have --

24 A. No. You have a measure of its
25 randomness. And so, essentially, in going from an

1 energy band to a peak band, we're taking the product of
2 two distributions, and you can estimate what the
3 standard error of the load factor is historically and
4 the --

5 You have the energy distribution, which
6 we've derived using this procedure we've been talking
7 about, and then you take the product of them, because
8 the peak is the product of load factor and energy. And
9 that's one of the things that isn't intuitively
10 particularly easy to understand because people are used
11 to thinking of adding uncertainties -- the variance of
12 the sum of two things being the sum of the variance
13 minus twice the co-variance.

14 But the only way you can estimate the
15 product of two things is by simulation, and quite often
16 the results you get are not intuitively what you expect
17 at all.

18 And, in fact, when we've done that, we
19 get the surprising result that the peak band is
20 narrower than the energy band. Other utilities have
21 found that, but we didn't wish to choose to do that
22 until we were much more confident in that sort of
23 result.

24 So, effectively, we have kept the peak
25 band and the same degree of uncertainty as the energy

1 band, pending further analysis.

2 Q. Mr. Burke, either I'm totally lost,
3 which is quite possible, or you haven't quite answered
4 the question I asked. Let me go back to the question
5 and see whether I can get it.

6 As I understand your description, you're
7 saying you can measure the uncertainty around your load
8 factor projection; right? But -- let me finish. But
9 what I'm asking about is how do you get the load factor
10 projection? And with no trend in past data, isn't it
11 right that you just said, "Let's make a guess and say
12 it's constant"?

13 A. No. That's not a guess. That's the
14 best forecast, given a series which is fluctuating at
15 random about a constant mean. And we've checked that
16 it does statistically fluctuate about a constant mean.

17 That's not a guess. That's -- you know,
18 some things have trends; some things stay constant.
19 That's the best forecast for the load factor.

20 Q. So when you said that the past data
21 doesn't have any discernable pattern -- you've said
22 that number of times in your past --

23 A. Doesn't have any discernable trend, I
24 think I said. Well, okay.

25 Q. Okay.

1 A. Both of them are true. It is a
2 random process around a constant mean for the last 20
3 years.

4 Q. Okay. Maybe I'm just going to skip
5 over to what is, after all, the point of all of this.
6 Your particular bandwidth methodology, the particular
7 way that you choose to describe uncertainty, can you
8 just give us an idea of which of these it picks up
9 totally and which ones it doesn't pick up, and which
10 ones it sort of partly picks up?

11 A. Pretty well the data issues. It's a
12 difficult question. I'll have to think about it for a
13 minute because this isn't particularly the way I would
14 categorize uncertainty.

15 I think probably the difficulty we're
16 having answering may relate to this hybrid approach.
17 That is, a lot of the issues associated with the data
18 reliability, the specification and so on, are captured
19 in the production of the forecast using the econometric
20 and end-use approaches. And to the extent that the
21 median forecast is wrong because of data problems or
22 absence of data, poor specifications and so on, that is
23 reflected in the general trajectory of the median
24 forecast.

25 And we had a single equation that fits

1 that forecast, tracks it well, and its fit -- in trying
2 with just a single equation to fit total load, I think
3 that is why the residual standard error may be fairly
4 large, compared to some other models, and the
5 co-efficient standard errors, well, they're not too
6 large, I have to admit. That may be where,
7 essentially, the extent to which those kinds of errors
8 are reflected in the uncertainty band.

...

1 [4.38 p.m.] I think that's right. I think that the
2 data uncertainties, the model specification
3 uncertainties, are captured in the extent to which one
4 can track the forecast with the single equation and
5 therefore are implicit in the residual standard error
6 of the equation and in the coefficient error of this
7 equation.

8 Q. It's far too complicated for me. In
9 simple terms, does that mean that your uncertainty
10 bandwidth captures those things, a hundred per cent
11 captures those things?

12 A. To the extent that it is possible to
13 quantify the impact of data uncertainty, specification
14 uncertainty, in the aggregate for total system
15 electricity demand, I believe the equation captures
16 those things, but does not capture structural changes
17 such as the remaining 8 to 16.

18 Q. So it doesn't capture the level of
19 reliability of your judgments? Like your economic
20 judgments, Kuwait will need more capital, Eastern
21 Europe will need more capital, things like that? It
22 doesn't capture the uncertainty associated with whether
23 those judgments are right, or it does?

24 A. Oh, looking at economic judgments.
25 Is that what you meant by economic judgment?

1 Q. For example, yes.

2 A. There are very many judgments in the
3 forecasts; and to a certain extent, a lot of them may
4 be offsetting. Indeed, each of the detail judgments,
5 it is not clear how any individual judgments
6 contributes to uncertainty about the forecast. I think
7 that's the problem of producing a band for the total
8 system. It is looking at the aggregate effects of all
9 of these elements that go into the forecast.

10 Q. I understand the problem but there is
11 an uncertainty about whether any given judgment is
12 correct, yes? Or how correct it is going to be?

13 A. Individually, there is an uncertainty
14 about each and every judgment of the thousands that
15 must underlie the median forecast.

16 Q. Let me get at this in my plodding
17 way. Is it intended that your bandwidth capture all of
18 those uncertainties in aggregate a hundred per cent?

19 A. It is the intent that the
20 relationship between GDP and load either through the
21 uncertainty in GDP itself or the uncertainty in the
22 relationship between GDP and load captures all of these
23 factors, yes.

24 Q. So, the only thing that isn't
25 captured is fundamental change, the structural change?

1 A. Yes.

2 Q. Am I right in assuming that because
3 you have an 80 per cent confidence band, that implicit
4 in that is an assumption that there is less than 20 per
5 cent likelihood of non-offsetting structural change?

6 A. I think that's the judgment we must
7 be making at this point in setting the forecast where
8 it is set, yes.

9 Q. Does that mean that there is sort of
10 an additional uncertainty associated with anything like
11 this beyond your bandwidth technique?

12 A. There is a class of uncertainty that,
13 as I have said, is unquantifiable. That makes it very
14 difficult to know where it is. And there is nothing
15 that one is going to do to eliminate that.

16 Q. I am not suggesting you are not doing
17 what you should be doing. I guess I am trying to
18 understand when you say the bandwidth now 17,900
19 megawatts, that 17,900 megawatts plus some additional
20 uncertainty which can't been quantified.

21 A. Well, this is the 80 per cent band.
22 You could have a 99 per cent band and get a much wider
23 band.

24 Q. That is not what I am asking you.

25 A. Well, I think it is, actually,

1 because as the confidence level increases, more and
2 more of these contingencies can be said to be included.

3 By 2015 what seems like an extremely low
4 probability event today may be quite important, and we
5 would dismiss it entirely at this point in time, but it
6 may be what turns out to determine load and it's
7 probably assigned a half a per cent probability by
8 anybody you ask their opinion about it today.

9 For instance, if you ask someone: What
10 is the change that we will be in depression in Ontario
11 for the next 25 years in a row? They will probably
12 say, "Almost no chance at all." It could happen.
13 Extremely unlikely. How much weight should be put on a
14 scenario like that? A tenth of a per cent, half a per
15 cent? I don't know. That's what's difficult. But
16 that is sort of is one way of getting an extremely low
17 result that would over 25 years put you way below the
18 low end of our band, but what is the probability of
19 that particular scenario.

20 Q. I want to come to the final point,
21 hopefully. With all of these uncertainties associated
22 with forecasting, the average lay person might say why
23 bother do it? What is it you learn from it? And even
24 the bandwidth you have projected is pretty wide; isn't
25 it?

1 A. I think the planners are having
2 trouble keeping up with it.

3 Q. Isn't it fair to say that there are
4 other things you learn from going through the process,
5 the techniques you use teach you a lot of other things
6 about interrelationships between variables and factors
7 in the economy, and that those are also a valuable
8 aspect of the process?

9 A. Of modelling uncertainty?

10 Q. Of modelling load or modelling GDP?

11 A. Oh. Well, first of all, there is a
12 premise here, I think, that you were sort of were
13 saying something about why bother doing it because it's
14 all so uncertain. Am I supposed to agree to that?

15 Q. No, I was saying one might ask that
16 question, yes.

17 A. I'm sorry, are you asking the
18 question?

19 Q. Okay, I am asking the question.

20 A. Pardon?

21 Q. I am asking the question. What's the
22 point if you have a wide uncertainty band?

23 A. Because it is the best information
24 you have for planning purposes. And I think if we all
25 agree not to bother planning, then we can abandon this

1 exercise. But essentially in order to plan, you need a
2 good sense of where you are going in the future and it
3 doesn't rule out that you can change your future, but
4 you do need to know where you would be if you didn't
5 take major steps. That's what the basic load forecast
6 is about and that's what we have attempted to do. I
7 think this gets back to one of the first things I said
8 in my direct evidence, which is we are trying to make
9 informed and balanced forecasts of the future.

10 Q. Do I take it then that in your view
11 you cannot plan unless you first forecast?

12 A. That's correct. And I discussed this
13 issue both in direct evidence, and I think various of
14 the intervenors were suggesting that targetting in some
15 sense was an alternative. Maybe I was reading
16 something into their questions. But my position is
17 that you cannot target meaningfully without
18 forecasting.

19 Q. Let me get back to the question I was
20 asking. During the course of the forecasting process,
21 your techniques teach you a lot about the relationship
22 between variables within society and within the
23 economy, don't they?

24 A. Yes.

25 Q. And that information is valuable

1 aside from forecasting?

2 A. Yes, absolutely. And one of the
3 major uses of the end-use system, as we have described,
4 is that it provides valuable information for the design
5 and later on evaluation of demand management programs.

6 Q. Now, it has been suggested that
7 instead of starting with a forecast and going to the
8 plan, you could start with the plan and figure out what
9 happened as a result of doing that, right? It is the
10 backcasting approach.

11 A. Well, I must say that's not quite my
12 understanding of backcasting. My understanding of
13 backcasting is that you set a goal. And I would have
14 thought of it in terms of some results like not to have
15 any growth in load, for instance.

16 Q. Yes.

17 A. Now, I guess if you are saying you
18 have already decided how you can achieve that goal,
19 then you are starting with a plan. I don't believe you
20 can meaningfully decide that you know that you can
21 achieve that goal until you have really figured out how
22 hard it is going to be to achieve, and you really can't
23 tell that unless if you have figured out what would
24 have happened if you didn't do all of the extra things
25 that you are going to do to somehow make zero per cent

1 happen instead of 2 per cent.

2 Q. Could the planners come back to you
3 and say, we don't really care what happens if we do
4 nothing because we know we are going to do something.
5 What we would like to know is can you run your models
6 and tell us what sorts of things would cause this
7 result, this let's say, zero load growth. Could you do
8 your models that way? Could you run your models that
9 way?

10 A. Yes, the econometric model, you would
11 be doing some pretty blunt things, it wouldn't be very
12 informative. But the end-use model you certainly could
13 produce theoretically an infinite number of scenarios
14 as to how combinations of load and efficiency and
15 whatnot in the future that gets you a particular
16 result.

17 The problem in practice is that there's
18 an infinite number of ways to do it; whether any of
19 them are feasible is yet another question. But if you
20 want to know is it possible to add up load to get zero
21 growth at a point in time in the future, you can
22 certainly do that with an end-use model.

23 And that's the reason why when people
24 have been asking us about sensitivities and we say
25 well, we haven't looked at that one, it's because there

1 is so many you can look at. You could decide to
2 eliminate this market, eliminate that market, do this,
3 do that. There are infinite numbers of ways of doing
4 that. Are they feasible, practical, acceptable,
5 desirable, any of those words. Very hard to tell. And
6 until someone makes it seem plausible that any one of
7 them is a useful avenue to pursue, it isn't
8 particularly useful for us to sort of paint the whole
9 picture. It is a lot of work.

10 Q. What I was talking about a minute ago
11 is backcasting, right, as you have redefined it. But
12 there is also scenario building which is different;
13 isn't it?

14 A. Scenario building is different, yes.

15 Q. And how is it different?

16 A. Well, a scenario is a complete
17 forecast, an alternative forecast perhaps in the way
18 the term is usually used, but you can certainly
19 describe our median case as a scenario. It is one way
20 of going from here to there, so to speak, within
21 internally consistent assumptions. We happen to think
22 that it is the most likely, the median case, so it's
23 our preferred scenario.

24 So there is nothing special about the
25 word "scenario," but it does require an internally

1 consistent set of forecast information. And it has
2 zero probability in and of itself.

3 Q. Am I right in understanding your
4 approach to posit a single future, a single line future
5 with variations on that future only?

6 A. Our load forecast is a single
7 scenario which is deemed to be the median, most likely,
8 whatever, pretty close in practice, scenario with a
9 associated uncertainty. That forecast has considered a
10 wide range of contingencies, and those go into the
11 formation of the judgments about the specific forecast.

12 For instance, there has been a lot of
13 discussion with Mr. Rothman about his GDP assumptions,
14 and certainly some consideration needs to be given to
15 departures from the median case. What sort of things
16 could cause departures? But having looked at the range
17 of possible outcomes for GDP, one is selected as the
18 basis, yes.

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24 ...
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1 [4:50 p.m.] MR. ROTHMAN: A. I hesitate to jump in
2 here.

3 Q. I am almost finished.

4 A. That's the only reason why I should
5 hesitate. I think it is important to recognize the
6 point about the forecast being a scenario, but that I
7 think I heard you ask a question that went something
8 like, is this a median forecast and there are
9 variations around it.

10 The point of the uncertainty band is to
11 capture at least some of what would be alternative
12 scenarios though not alternative scenarios that are
13 very different; that is, when we build a scenario we
14 build it up, we build the forecast by making a set of
15 assumptions, that's really the discussion that we had
16 on Thursday.

17 We could build a different forecast with
18 a different set of assumptions. Any time you change
19 one of those assumptions you will build a different
20 forecast. It's important when you change one
21 assumption to build a different forecast as a scenario,
22 that is, to keep the assumptions together, coherent, so
23 that you don't have an assumption from one source here
24 and an assumption from another source here, coming from
25 very different points of view and producing assumptions

1 that aren't necessarily compatible and try to put them
2 together into a forecast. That's why we do a scenario.

3 But I think that where we are talking
4 about changes in assumptions that aren't radical
5 changes, that really has to be -- not changes in
6 assumptions, differences of the actuals from our
7 assumptions within the same pattern, in effect, that
8 has to be captured in the uncertainty band rather than
9 captured by -- rather than produce what would be an
10 entire alternative scenario.

11 Q. Now, there are other areas in which
12 you use scenarios today; right? Non-load forecast
13 areas?

14 A. Yes

15 Q. Didn't you testify that you use it
16 for your treasury division?

17 A. Yes.

18 Q. Do I understand your testimony to be
19 that you used to provide uncertainty bandwidth around
20 interest rate projections for your treasury division
21 and they didn't find that very useful and actually used
22 the scenarios instead?

23 A. Yes, and for precisely the reason
24 that I was talking about. They needed something more
25 than just a single variable uncertainty with no notion

1 of what the causal effects were. They needed a
2 coherent scenario so that they could put together the
3 variables that are relevant to them.

4 MR. BURKE: A. I would like to add at
5 this point that the reason we are producing an
6 uncertainty band is that the users of the load forecast
7 information do not find scenarios in themselves without
8 some probability that they can assign to them useful
9 for planning purposes.

10 We did look, as we have discussed earlier
11 and which is located in one of the Northwatch
12 interrogatories that's already on the record, that
13 alternative scenarios as a basis for contingency
14 planning but decision-making based on alternative
15 scenarios seems to be very difficult in practice.

16 Q. And treasury division can do it but
17 the planners can't?

18 A. Maybe it's the nature of the problem
19 they have to solve.

20 MR. ROTHMAN: A. Treasury division uses
21 it to test their financing strategies against the
22 alternative scenarios.

23 MR. BURKE: A. It may be that
24 judgmentally they are much happier with assigning
25 weights to scenarios and doing that very judgmental

1 process that is involved when you start to use
2 alternative scenarios as a basis for planning.

3 But the system planners who have to weigh
4 decisions and risks to the plan associated with high
5 and low or changing or whatever patterns of load, find
6 it not feasible to do that with a series of scenarios
7 which no one can tell them the likelihood of. They
8 don't wish to assign probabilities to the scenarios;
9 they want someone to assign probabilities for them.
10 And the only way we can really assign probabilities to
11 future load information, which is really what the range
12 forecast is, is through a range or a probability
13 distribution.

14 Q. Maybe I am misunderstanding this. Is
15 the reason why you use scenarios in one area and
16 bandwidth methodology in the other area simply that the
17 end users in each case have a preference for one or the
18 other, or is there some fundamental difference between
19 planning financing strategy and planning building
20 strategy?

21 A. I don't know that I want to speak for
22 the treasury people, but I think that it is fair to
23 observe that the nature of the planning information is
24 probably a function of what is being planned, how
25 useful it is to arrive in certain forms or others, and

1 where the judgments are and are not made.

2 In practice, for load forecasting
3 purposes, when we produced contingency scenarios that
4 had almost no probability of occurring but certainly
5 bounded the likely futures, that information was almost
6 of no value to system planners. They did not know how
7 to plan under-uncertainty given that sort of
8 information, and they really needed some way to weight
9 the information in a meaningful sense.

10 And given that each individual scenario
11 did not claim to cover the universe, that is, you could
12 not provide a set of scenarios which, when added up,
13 covered all of the universe. The only way you can do
14 that is to come up with some very boring scenarios that
15 each have a sort of a wedge into the future and cover
16 the same thing as an uncertainty band.

17 In effect, that is what in the end we are
18 doing. We are using the uncertainty band to provide
19 probabilities on extreme outcomes without having to
20 specify exactly which set of events causes that
21 outcome, and there are many ways to have extreme
22 outcomes when you are dealing with something as diverse
23 as electricity demand. So it almost doesn't matter how
24 you get that outcome; it matters what is the chance
25 that you will end up in that extreme situation.

1 Q. I take it from the fact that you use
2 both methods, depending on what the users ask for, that
3 you don't have a particular preference for using a
4 bandwidth methodology or using scenario generation
5 methodology?

6 A. We used to produce both. And for the
7 load forecast, the demand for scenarios dried up and
8 it's a lot of work so we stopped doing it.

9 Q. If the planners came back to you then
10 and said, we have got all these wonderful new models
11 and we would like you to run some scenarios, let's say,
12 X, Y and Z, and A, B and C, your techniques could do
13 that fine, couldn't they?

14 A. Yes.

15 Q. So if they said to you, do a scenario
16 in which we, Ontario Hydro, are limited to demand side
17 management and non-utility generation, we have no other
18 generation options, could you do that?

19 A. Well now, I need some information in
20 addition to just that. I need to know -- the price of
21 electricity and, for that matter, the price of natural
22 gas would start to be important.

23 Q. But they could specify that and you
24 could run that scenario?

25 A. If they specify all of that stuff,

1 certainly the structures are there to analyze, again
2 given all the caveats we made about those prices not
3 moving out of the range for which we have comfort in
4 the elasticities; as soon as that happens, we would
5 then have to do what amounts to a micro analysis of
6 what decisions people would make under extreme
7 circumstances.

8 Q. Even if you did that scenario, there
9 would still be uncertainty around that scenario,
10 wouldn't there?

11 A. As we have said repeatedly, there is
12 absolutely no certainty with any scenario. The
13 probability of any individual scenario is zero. You
14 have to define a region around it somehow in order to
15 assign probability to it, and that's a pretty arbitrary
16 exercise.

17 Q. My last question is, the planners
18 haven't actually asked you to do any of that, produce
19 that sort of scenario or any scenarios?

20 A. They used to. But now since about
21 1988 they have been interested in a probability
22 distribution about the load forecast. In my view that
23 represents an evolution from scenarios to uncertainty
24 bands; that is, it was very popular to look at
25 scenarios in the early '80s and it certainly does

1 sharpen a corporation to consider the contingencies
2 with which it could be faced.

3 Having done that, though, you begin to
4 learn what it is you can and cannot react to, and where
5 flexibility, which is the main outcome of these sorts
6 of exercises, can lead to you. And having addressed
7 where is it that you can buy flexibility, if you really
8 want to make the trade-offs as to how much flexibility,
9 you need to be able to assign weight to those chances,
10 and that's where uncertainty bands come in. So I would
11 say they come after a consideration of scenarios.

12 MR. SHEPHERD: Mr. Chairman, I have no
13 further questions.

14 THE CHAIRMAN: All right; we will stop
15 for the day.

16 I'm sorry, Mr. Thompson, but even if you
17 do take five minutes, that would be five minutes too
18 long. We have to stop at five o'clock sharp tonight.

19 THE REGISTRAR: This hearing will adjourn
20 until tomorrow morning at ten o'clock.

21 ---Whereupon the hearing was adjourned at 5:00 p.m.,
22 to be resumed on Tuesday, May 14, 1991, at 10:00
a.m.

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